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ABSTRACT

This report focuses on interactive multimedia delivery platforms available for distance education. An introduction addresses the role of distance education and open learning in covering training needs and advantages of interactive multimedia in training. Chapter 2 proposes a multimedia skills evaluation framework and examines the elements of this functional requirements framework against which technology options could be evaluated with regard to business, user, and policy needs. Chapter 3 presents technology options available for implementing distance education. Sections 1-4 examine personal computers commonly used in business, multimedia extensions available for personal computers, integrated solutions, and telecommunications. Section 5 focuses on authoring. Section 6 examines strengths and weaknesses of the options with respect to the outline framework established in chapter 2. Chapter 4 begins by examining the process of implementing a multimedia distance learning system into an organization. Two case studies illustrate the multimedia distance learning environment in practice, a hotel scenario to show opportunities in the tourism industry and a dealer location and a supplier factory from the motor industry. Chapter 5 outlines scenarios for the successful implementation of multimedia distance learning. Chapter 6 makes recommendations with regard to raising awareness, needs analysis, creation of a hardware base, software development, and standardization. (YLB)

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HUMAN RESOURCES

EDUCATION
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# TECHNOLOGY OPTIONS FOR MULTIMEDIA IN DISTANCE LEARNING

by

Dr. P. SHERWOOD-ROBERTS

and

Dr. P. VERVEST

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
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A report for the Commission of the
European Communities :
Task Force Human Resources, Education
Training and Youth

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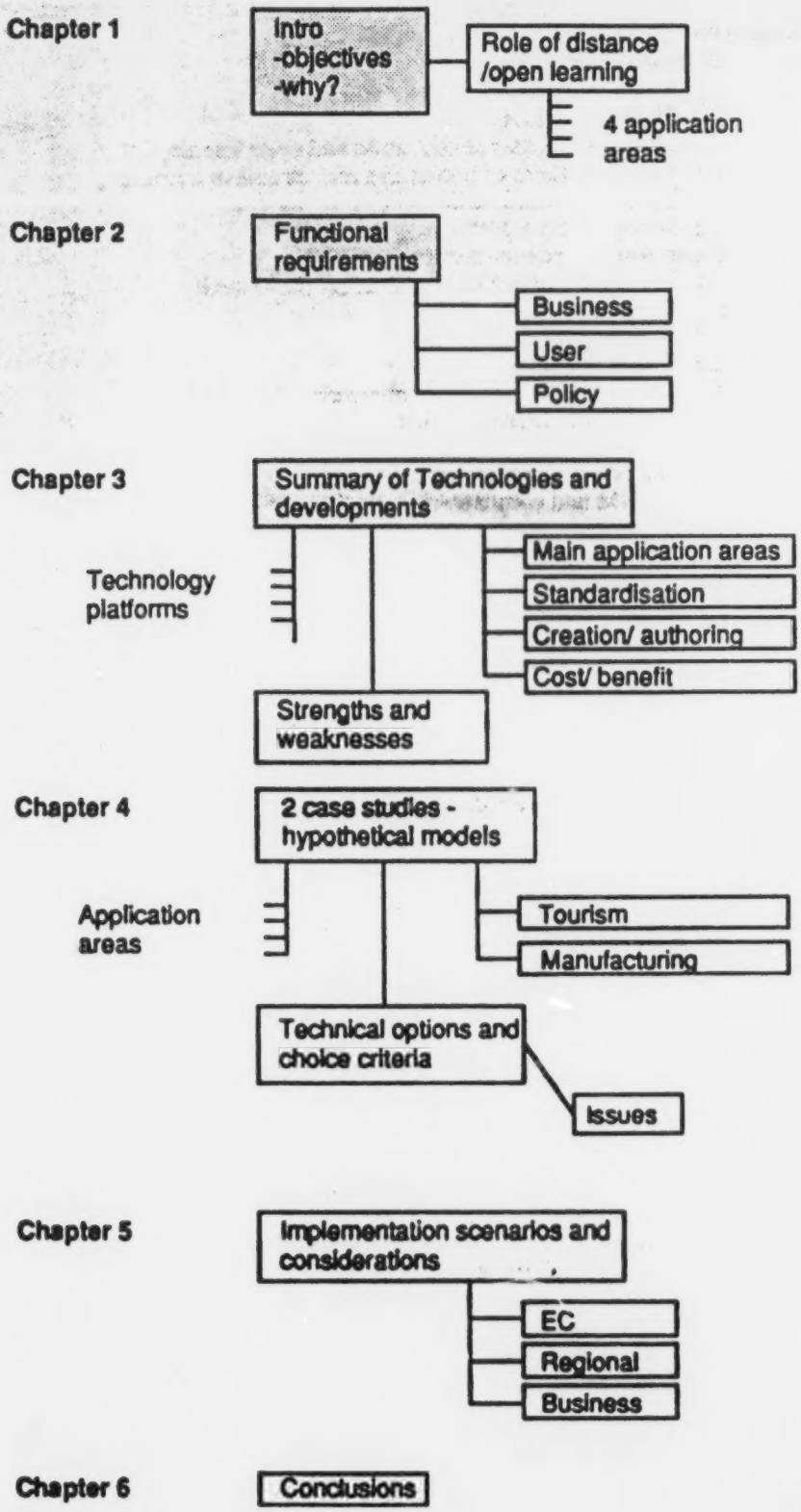
# Technology options report structure



# EXECUTIVE SUMMARY

To assist in the development of policies in European distance education, Multimedia Skills has been asked to prepare an overview of the technology options, taking into account both short term needs, and longer term possibilities.

It is in the context of the need for skills development, **the proven effectiveness of multimedia distance learning, and the expanding range of commercially available hardware and software,** that this report examines the technology options and the policy issues surrounding the wider use of multimedia distance learning techniques, particularly with regard to SMEs and remote areas.

The technology options review is based on an assessment of the functional requirements for European distance education/ open learning, **focussing on the hardware and software delivery platforms available or appearing now**. It outlines the capabilities of each platform, and the main backers for each of them.

The platforms are compared with respect to the likely functional requirements, but these can only be established in detail after a thorough needs analysis. It has not been the purpose of this report to undertake this needs analysis, rather to identify the range of functions that could form the basis of such a needs analysis.

The objectives of the report are:

- **to propose the functional requirements for the use of distance learning technology in view of European needs for skills development in various levels of education and training**
- **to recommend which technology options are available and to suggest choice criteria for short term and longer term policy in distance/open learning**
- **taking into account the above, to outline implementation scenarios from a technology point of view and to discuss the most important factors for success**

## Summary

- technology has already been proven to be very effective for distance learning
- functional requirements are phrased in terms of business, user and policy needs
- the technology exists now for distance learning applications
- the introduction of multimedia involves five major stages, each of which is critical to successful implementation
- a software led implementation scenario provides fastest take-up
- conclusions and recommendations

## TECHNOLOGY HAS ALREADY BEEN PROVEN TO BE VERY EFFECTIVE FOR DISTANCE LEARNING

Distance education/open learning has become a vital component of European competitiveness. Training and education are more important than ever for both the small and large organisation, and providing access to training is "a prime objective" of the European Commission, as stated in the Programme of the Commission for 1991.

It is equally important to ensure a balanced development of Europe, involving the less advanced parties of the European Community and the wider Europe, in the increasingly complex industrial and services markets.

Technological developments, particularly in the area of multimedia, have created new choices for distance education/open learning, that have to be matched with the changing and different needs in Europe.

Hundreds of multimedia distance learning programmes covering an extremely wide range training needs, both on-the-job and at open learning centres, have demonstrated that technology can be applied to increase the productivity of training, in the same way that technology has helped increase the productivity of many other jobs.

Skills development via interactive multimedia involves the use of computers and electronic communications to deliver training using text, graphics, sound, pictures and video in the appropriate mix for the subject being learnt. No new technologies are needed although present systems are being improved and extended continuously. The pedagogical issues have been well tried out in practice and research is showing how improvements can be made to the already very effective programmes being produced.

Many evaluations of the effectiveness and efficiency of interactive multimedia training have been undertaken. A growing number of studies indicate:

- **reduced learning times**
- **improved knowledge retention**
- **more effective problem solving skills.**

For many skills development applications, multimedia has shown itself to be at least **as effective, and in many cases, more effective than conventional training techniques**. In some areas, e.g. flight simulators for aircraft pilot training, it is the primary training method.

Technology can help overcome the shortage of trainers and make training more accessible to a wider range of learners than conventional methods alone can address.

## FUNCTIONAL REQUIREMENTS CAN BE EXPRESSED IN TERMS OF BUSINESS, USER AND POLICY NEEDS

- four main training areas are currently being addressed by multimedia:
  - on-the-job technical skills
  - on-the-job interpersonal skills
  - open learning
  - training the trainers/managers

- business needs are addressed by three main questions:
  - how well does the system fit into the business environment
    - on site on the desk?
    - on site stand-alone?
    - at an open learning centre?
    - at home?
  - what level of support exists for the system
    - availability?
    - local support?
    - user and developer experience?
    - software tools for development?
  - does the software meet business requirements?
    - multi-platform
    - easy to update
    - provide monitoring and assessment of learners progress
    - downloadable for remote areas

- user needs are addressed by four main questions:
  - how easy its it to learn to use?
    - consistent user interface
    - intuitive user interface
  - how many styles of interaction are available?
    - different people have different learning styles
    - different subjects require different techniques
    - different elements of a course require different techniques

- what devices are available for interacting with the system?
  - voice and pointing device input
  - special devices for disadvantaged users

  - what presentation media mix is available?
  - text and graphics
  - pictures and moving video
  - sound

- The main policy question is how to ensure maximum benefit from the various Community programmes relating to multimedia distance learning

## THE TECHNOLOGY EXISTS NOW FOR DISTANCE LEARNING APPLICATIONS

- any of the personal computer platforms widely used in business can support the multimedia options
  - IBM and compatibles
  - Apple
  - Unix workstations
  - others, Commodore, Acorn, NeXT, etc
- the multimedia options for PCs start with the simple addition of sound
  - digital audio
  - CD-ROM including CD-Audio
  - CD-ROM plus digital audio and graphics
  - CD-ROM with digital video processing
  - analogue video, video tape and disc
  - analogue video with digital processing
- the addition of electronic communications to interactive multimedia extends distance learning possibilities
  - broadcast television for programme distribution
  - data communications for access to remote data bases
  - networks for electronic interaction with trainers and other learners
- authoring, the efficient creation of the programmes, is critical to the future success of any hardware platform
  - conventional computer programming languages
  - programming language related authoring systems
  - graphical user interface based authoring systems

## THE INTRODUCTION OF MULTIMEDIA INVOLVES FIVE STAGES, EACH OF WHICH IS CRITICAL TO SUCCESSFUL IMPLEMENTATION

- awareness and understanding is needed to identify the opportunity
  - management
  - trainers
  - staff

- a detailed strategy is needed to ensure short and long term benefits
  - business objectives
  - equipment selection
  - implementation plan
  - evaluation criteria

- a major effort is needed to prepare for organisational and operational changes
  - preparing the staff
  - providing the support structure for the learner
  - creating an appropriate learning environment

- an implementation team should install and instruct the users
  - install equipment and software
  - start using programmes

- future programmes should learn from experience of earlier ones
  - evaluate business benefits
  - analyse user comments
  - proceed to next programme
  -

Widespread take-up of multimedia will take longer if left wholly to market forces because:-

- without an installed hardware base, SMEs cannot take advantage of multimedia software

- independent publishing establishments will only become active when a significant installed hardware base exists

## A SOFTWARE LED IMPLEMENTATION SCENARIO PROVIDES FASTEST TAKE-UP

### no clear winner

In this scenario the market dictates no particular winner, and the various platforms follow their own unique positions.

### the consumer electronics industry leads

In this scenario we see CD-I type systems prevailing, with these capabilities also appearing as PC plug in cards, providing a low cost option due to the high volumes in the consumer market.

### PC industry leads

In this scenario CD-I type systems remain primarily as consumer platforms and do not become a major multimedia platform for business.

### publishers lead

In this scenario the major European publishers take the lead and define a minimum functionality set for the software which allows them to produce multi-platform programmes which avoids the PC versus CD-I issue.

### education and industry lead

In this scenario education and large, small and medium sized industry users define a joint set of requirements and lead suppliers into a reasonably standardised set of functions for implementing multimedia across all the major platforms.

Software for the creation of multimedia programmes based on the emerging graphical user interface environments is becoming more powerful and easy to use. This software is also tending to become multi-platform. It is expected that this trend will continue and a reasonably standardised way of developing multimedia programmes will emerge with help from industry groups. A software led scenario will provide both publishers and hardware suppliers with a more stable market than a hardware led scenario.

## CONCLUSIONS AND RECOMMENDATIONS

Multimedia is a well proven technology for distance learning. However the awareness of its potential to greatly enhance the productivity of training is generally low throughout the Community. Also, there are many technology platforms which can deliver varying levels of multimedia functionality with differing costs and quality factors. These platforms include hardware and software, and both need to be taken into account when considering technology options.

Technology should only be selected for any particular purpose once the skills development needs have been established. The most appropriate technology or combination of technologies will depend very much on the type of training being given, to whom it is being given, where and when. No single technology will be 'best' for all situations all of the time. A detailed needs analysis will help establish the characteristics required of the technology for the training tasks identified.

### awareness

There is a need to raise the level of awareness in the Community of the benefits of interactive multimedia training for business and for individuals. To meet the overall objective of maintaining a healthy economic balance across the Community particular emphasis should be put on remote and less favoured regions.

**We recommend that the Commission should investigate the feasibility of establishing national or regional multimedia skills development and demonstration centres.**

**The objective of this investigation would be to identify the key localities for these centres, their organisation, and the selection of hardware and software for the awareness programme.**

### needs analysis

Multimedia distance learning has been used very effectively by a number of large companies. Large companies need small and medium sized enterprises to supply many of the goods and services they require, but SMEs do not typically have the resources to use the multimedia technologies.

Large companies in conjunction with governments and trade associations can work together to find ways of giving SMEs access to appropriate multimedia distance learning. This task can only be started once there is a general agreement as to what the appropriate training needs are, both within big organisations and for SMEs.

**We recommend that Europe's top 100 companies should work with the European Commission and other relevant and interested parties to identify priority needs for themselves and for the SMEs working with them.**

**The objectives of this analysis would be to document immediate Europe-wide training needs that can be addressed by multimedia, and to create a technology selection framework for making choices about which technologies should be used to deliver this training.**

## hardware

The creation of a hardware base for delivering multimedia training is essential to stimulating the creation of published skills development materials.

**We recommend that the Commission should work together with large companies and national bodies to investigate the approaches to building a large base of hardware platforms suitable for the priority applications identified in the needs analysis.**

**The objective of this investigation would be to find ways of reducing the cost of the equipment, to SMEs in particular, to help ensure rapid take up.**

## software

The availability of appropriate software is the key to the success of multimedia distance learning. However, as with most creative activities, many solutions are possible for a programme meeting a particular training requirement. It is difficult to prejudge which method will work best. What is certain, is that many of the published programmes have worked well.

**We recommend that the priority training applications should be developed and that this development should be heavily supported by the European Commission.**

**We recommend that these applications should be strongly promoted to major publishers and that developers should produce programmes that are multi-platform.**

**We further recommend that both commercially used authoring approaches and those nearest the market from the research programmes should be used to produce these programmes to determine some 'best' authoring practices.**

## standards

Many standards are defined or are under investigation in the multimedia arena. The consumer electronics led standards for CD-Audio and CD-I have been published and accepted by a number of major suppliers. The International Standards organisation has defined a still picture encoding standard and has released a draft moving picture encoding standard. Laservision is a world wide standard for videodisc. Similarly there is a market driven trend towards a small range of standardised graphical user interfaces for personal computers.

**We recommend that the Commission should promote an adequate level of standardisation to ensure that publishers can produce multi-platform applications.**

**We recommend that a framework of minimum functionality be developed for the priority applications and that this standard should be strongly promoted to all suppliers.**

# Chapter 1. Introduction

## 1.1 MULTIMEDIA SKILLS

Multimedia Skills helps organisations improve their business by the effective use of multimedia information technology. Multimedia is being applied to all aspects of business, from sales and marketing, to shop-floor operational systems, office work and many levels of management. In addition to helping in operational systems, multimedia has also proven to be a very successful adjunct to conventional training in all these areas.

Multimedia distance learning applications, both on-the-job and at open learning centres, have demonstrated that technology can be applied to increase the productivity of training, in the same way that technology has helped increase the productivity of many other jobs. It has been shown by hundreds of training programmes covering an extremely wide range training needs, that technology has a significant role to play in skills development.

The Task Force, Human Resources, Education, Training and Youth has asked Multimedia Skills to prepare a policy document on the available options for using technology to address Europe-wide distance education with the following objectives:

- **to propose the functional requirements for the use of distance learning technology in view of European needs for skills development in various levels of education and training**
- **to recommend which technology options are available and to suggest choice criteria for short term and longer term policy in distance education/ open learning**
- **taking into account no. 2 above, to outline implementation scenarios from a technology point of view and to discuss the most important factors for success**

## 1.2 SKILLS SHORTAGES

A comprehensive report on "Skills Shortages in Europe" has been produced by the Industrial Research and Development Advisory Committee of the Commission of the European Communities (IRDAC). The points made in the rest of this section are a summary of the relevant issues surrounding the use of technology in distance learning to address these skills shortages.

Europe is faced with a number of challenges in the area of education and training. There is high unemployment in some areas combined with skills shortages in others, a decreasing number of school leavers and an ageing population. Allied to this are forecasts that there will be a further reduction in the need for unskilled workers and a corresponding increase in the need for a more highly skilled labour force.

The lack of investment in the areas of education and training during the 1980s, has resulted in an ever increasing 'skills gap', according to IRDAC. The implications are twofold: first, newcomers to the labour market as well as a large segment of the established workforce will have either an inadequate basic education, or out of date skills, or both. Second, new jobs are only likely to emerge in areas where the provision for vocational training or re-training is sufficient to meet the need.

It is generally agreed that a direct relationship exists between education and training and industrial competitiveness. A decline in the effectiveness of education and training will result in a similar decline in industrial competitiveness.

There is a clear need for continuing education and training to upgrade as well as update the skills of the workforce, by:

- improving the level of education and training at all levels;
- continuing training which is flexible and closely aligned to changing skill requirements and work patterns;
- young entrants developing adequate skills for the labour market;
- European investment in human resources, training tools and technology.

Education and training must be responsive to the wants and needs of industry - education and training should be supplied in relation to the demands of business function.

There is a clear need for educational institutions and industry to provide new and better methods in education and training that are effective, efficient and flexible to complement conventional methods.

**Distance education, will be one of the key methods used for delivering education and training throughout the European Communities during the 1990s**

## 1.3 THE ROLE OF DISTANCE EDUCATION AND OPEN LEARNING

Large organisations are increasingly replacing conventional training with distance or open learning. Conventional training focuses on the trainer as the scarce resource and the trainees are taken to the trainer at a predetermined time and place to suit the trainer. The training is a one-off event and is not normally repeated.

Distance learning on the other hand reverses this focus and takes the training to the trainee at or near the place of work. The training can be undertaken at a time and place to suit the trainee, and can be continuously reviewed as required.

The potential for increasing the efficiency of training by bringing it to the trainee is well understood. Most conventional tuition costs are only part of the the total training cost. Accommodation, travel and time away from the job usually significantly exceed the cost of tuition. Many courses away from the job are also given at the wrong time for the trainee, e.g. induction training six months after joining a company, and often bear little relation to the way the job is actually done on a day-to-day basis.

Although correspondence courses, for example, have been an effective method of distance and open learning for many years, it is the development of interactive multimedia technology over the past ten years that has increased the scope and effectiveness of distance learning for a wide range of industrial and commercial skills development tasks.

There are many training needs covered conventionally either in the classroom or on-the-job with an experienced person or trainer. To help identify the role of distance learning four main training application areas can be identified. On-the-job technical and interpersonal skills, open learning, and the training of trainers and managers in the use of distance learning.

**There are four main training application areas that can be identified. These are:**

- **on-the-job technical skills**
- **on-the-job interpersonal skills**
- **open learning**
- **training the trainers/managers**

1.3.1 technical skills are where people are dealing with equipment, knowledge or procedures. On-the-job technical skills training takes place at or near the work place and teaches staff how best to use their equipment and knowledge of products and procedures to increase productivity. A degree of technical skill is needed in every area of business. In many cases on-the-job training will make use of the computer environment which already exists at the job location.

Some examples of on-the-job technical skills are:

- office and clerical skills - word processing,archiving,administration, procedures
- management tools - financial modelling, budgeting, project planning,
- drawing, layout and design work, presentation aids
- operation of computer controlled machinery and processes, requiring dexterity
- equipment maintenance and fault finding
- product and organisation knowledge



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***On-the-job interpersonal and technial skills training***

1.3.2 interpersonal skills are where people are dealing with other people. On-the-job interpersonal skills training takes place at or near the work place and teaches staff how to communicate and work with others both within and outside the organisation. Everybody in an organisation should be aware of the importance of interpersonal skills and be quite clear what skills they must develop specific to their job.

Examples of interpersonal skills training include:

- language training
- personal communications skills
- sales and marketing training
- dealing with suppliers and customers
- interviewing, and various people management skills

**1.3.3 open learning** covers training away from the working area, in a designated training room, or outside of the organisation in such places as colleges or the home. Open learning is essentially a system which allows the learners to work undisturbed when they want or need to, and at their own pace. The emphasis is on flexible modular learning concepts which free the learner from the time and place constraints of the classroom environment.

Whereas on-the-job training is primarily focused on immediate skills needed for the day-to-day effective execution of a persons job, open learning focuses more on enrichment of skills for future needs. This of course also covers all the on-the-job technical and interpersonal training applications but has a much wider scope. Open learning addresses education of the work force in such areas as basic and advanced principles and skills, new technologies and processes, etc, thus preparing people for the ever changing environments of the future.

**1.3.4 training the trainers/managers** ensures that trainers and managers understand the concepts, technologies and benefits of open and distance learning - a method of training far removed from the traditional classroom approach.

Like all other employees, trainers need to understand the new techniques and technologies available for the improvement of productivity in their jobs. IRDAC has concluded that

> **"..the absence of change at management levels could make the introduction of new technology counter-productive .... perhaps the biggest challenge presented by technolgy advance is not the acquisition of the knowledge itself, but rather a need for training in the management of technological change"**

The move from a conventional classroom to a distance learning environment means a change in the way the training process operates, and the training tools and technology used. Trainers need to be aware of the changing role this offers them. It can multiply their productivity and allow them to use their time more effectively.

Managers also need to understand the role of technology in training and adjust the organisations procedures so that on-the-job training and open learning become as much a part of their technology strategy as other operational uses of technology.

Assimilating the experience already gained in interactive multimedia training, studying the many existing programmes and determining appropriate techniques for their own situation is a major learning activity for the trainers and managers alike.

Demonstration centres have proven effective in increasing the awareness of managers and trainers. Such demonstration centres provide a facility where people can spend time to study a wide variety of training programmes that have already been implemented. They also provide the opportunity to attend a variety of training programmes on how to go about introducing the concepts of distance learning into an organisation, and how to actually make the programmes.

## 1.4 THE ADVANTAGES OF INTERACTIVE MULTIMEDIA IN TRAINING

Distance education uses a wide variety of training delivery media, such as text , drawings and pictures in books, brochures, etc, video and audio, either broadcast or on tape, and computer based training.

However, books, video and audio by themselves are passive media: the user does not interact with them. Computer based training on the other hand allows the user to interact with the material. This enables a 'conversation' to be established between the user and the system.

**According to research conducted by the British Audio-Visual Society we remember about:**

- **10% of what we read**
- **20% of what we hear**
- **30% of what we see**
- **50% of what we see and hear**
- **80% of what we say**
- **90% of what we say and do at the same time**

Interactive multimedia systems combine the known communications power of television, with the flexibility and control capabilities of computers. With interactive multimedia distance learning systems, the student is actively involved in the learning process. It is a see, hear and do environment.

Many evaluations of the effectiveness of interactive multimedia training have been undertaken. A growing number of studies indicate **reduced learning times, improved retention, more effective problem solving skills.**

**A major study for the US Defence Department concluded that interactive multimedia instruction**

**"is more effective than conventional approaches ... can increase the effeciency with which training time is used by increasing opportunities for practice and requiring students to participate more actively in instruction "**

Fletcher, J Dexter: 1989 • Report to congress on the Potential of Interactive Videodisc Technology for Defense Training and Education • Institute for Defense Analysis (IDA)

## 1.5 INTERACTIVE MULTIMEDIA TRAINING IN PRACTICE

To remain competitive in world markets large European companies have to keep up with technological change, continuously improving productivity of both manufacturing processes and organisational structures. This implies a continuing need to train and retrain employees. Large companies have used multimedia to achieve these training requirements, but few small and medium size companies have managed to do this as yet.

**Business is changing faster than ever before:**
- **rate of new product introduction**
- **rate of change of market conditions in demand, supply, and competiton**
- **need to train 'new' sorts of employee, the 'participative' organisation**
- **need to retrain employees to cope with new work practices and technologies**

**Overview of some published evaluations of interactive multimedia training**

**Jaguar Cars**

- 150 videodisc systems for sales promotion at British dealers and public meeting places (eg. airports)
- interactive videodisc training systems in 115 workshops for training mechanics on new model
- four-day training courses reduced to two days; calculated saving of £300 per day/ per person, which amounts to an average saving of £6260 for each dealer per year on basis of training time reduction by eight to twelve days per dealer

**IBM**

- In Europe, 1500 videodisc players for sales support of the IBM PC, and for dealer and technician training. System operates with touch screen and can be linked to videotex
- IBM Deutschland is using the LTS 90 learning system in over 100 videodisc self-teaching stations; training hardware and software since summer 1989 also available to customers; savings compared with conventional training is 36%.

**Lloyds Bank**

- 1500 PC/Videodisc player systems for personnel training with additional benefits for customer information. Training time could be reduced from 18 hours to about 12 to 14 hours

**ARO**

- sales support system in 93 German carpet retail outlets, connected to central data bank. Thus complete collection of valuable hand-made carpets, can be shown in each outlet. Customer's selection is delivered to the home for a decision. Turnover in hand-made carpets rose by 300% within a half year after installation of systems

**B & Q England**

- 300 videodisc training stations in DIY centres. As effect of interactive video programme on electronic stocktaking B & Q estimates annual savings of £50,000 per store

**British Telecom**

- 200 interactive training stations. Reduction of training cost per person from £150 to £15

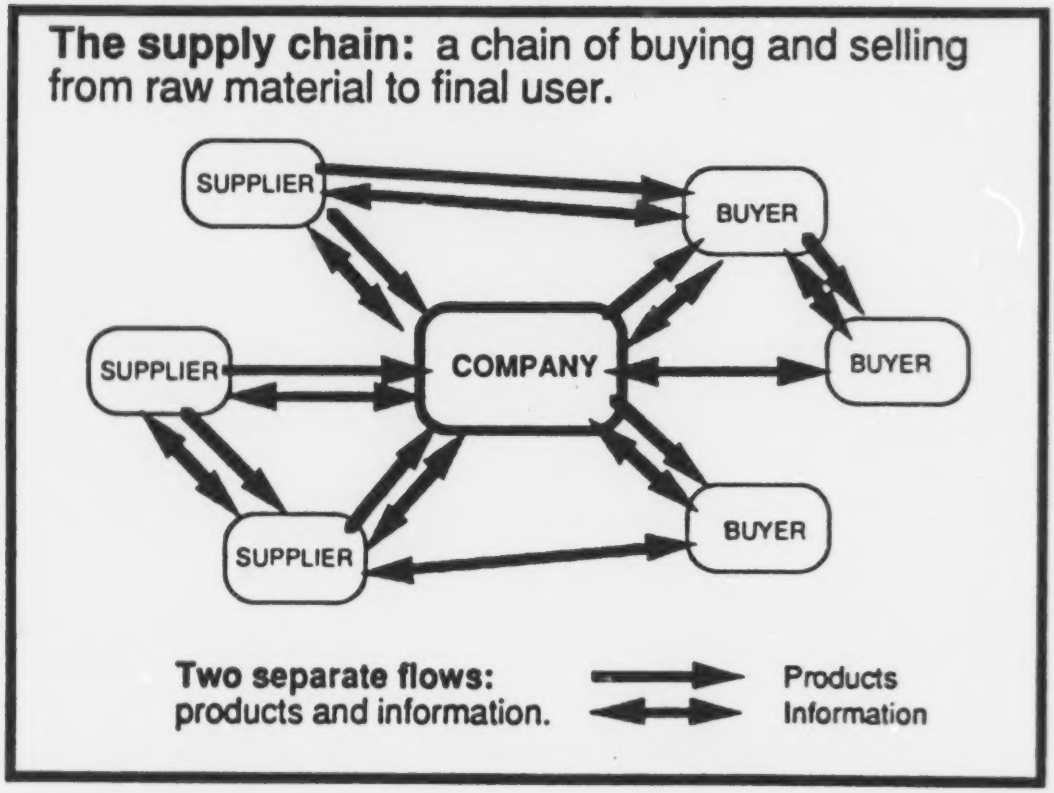
**Institute for Defense Analyses (IDA), USA**

- 31 studies assessed with the conclusion that interactive multimedia training can more effective and more efficient than conventional training

The concept of the supply chain is useful in understanding the respective roles of large and small to medium size enterprises.

Organisations do not exist in isolation within any significant market, there is a chain of buying and selling from raw materials to the ultimate user. Most organisations both buy and sell a wide range of goods and services. A large organisation will typically depend on many smaller organisations providing goods and services which it does not consider cost effective to provide from its own internal resources.

The two main elements of the supply chain are the products, goods and services which are bought and sold, and the related information transferred between the buying and selling organisations. Major companies have the strength and the need to force the pace of technological and procedural change on both goods and information exchange onto their suppliers and customers. On the buying side, if local suppliers cannot meet their requirements, there is a world market that can be accessed for many of the goods and services needed. On the selling side, customers, such as car and computer dealers, can be forced to change their way of working to suit the requirements of the manufacturer.




Large organisations also have the need, and the strength, to invest in new technologies internally to improve productivity. Multimedia has been applied on a very significant scale to their training needs by many large companies. These range from IT companies such as IBM, motor manufacturers such as Jaguar, financial institutions such as Lloyds Bank, retailers such as B&Q, and service providers such as the UK Post Office and British Telecom.

Unfortunately, small and medium sized enterprises have so far largely missed out on the benefits of interactive multimedia, due to the high costs of installing and maintaining significant technology based distance learning programmes. However, successful distance learning partnerships between large companies and SME's have been forged.

In the motor trade, for example, the manufacturers are introducing more and more technology into their cars. For dealers to maintain these more sophisticated systems it is necessary for them to re-train their workforce rapidly and continuously. By themselves, it would be hard for the dealers to justify the costs of multimedia, but with the help of the manufacturers, distance learning can be used to keep the workforce up to date. Both parties benefit. The manufacturers have a competitive advantage in being able to influence the quality of service on their vehicles and introduce models more quickly, and the dealers can undertake repairs faster with a highly skilled workforce thereby reducing labour costs.

Jaguar, Ford and IBM are examples of companies which provide interactive multimedia training programmes to their suppliers and dealers in Europe.

## 1.6 SCOPE OF THE REPORT

The focus of this report is on the hardware delivery platforms available now, or announced to be available within a few years. It outlines the capabilities of each platform, and the main backers for each of them. The platforms are compared with respect to the likely functional requirements, but these can only be established in detail after a thorough needs analysis. It has not been the purpose of this report to undertake this needs analysis, simply to identify the range of functions that could form the basis of such a needs analysis.

The case studies used to illustrate the points made in the discussion of the technology options are entirely fictional. They serve only to highlight the sort of training situation which might pertain in some years time. They are based on technology available today, and to some extent draw from actual experience in related fields. But they are not descriptions of any existing situation.

The scenarios outlined for the successful implementation of multimedia distance learning are not based on field research with users. They are based on discussions with European Commission officials and draw on the experience of the authors in helping many users implement multimedia distance learning systems.

There is no shortage of evidence on the benefits multimedia distance learning can bring to an organisation. However, the high costs and low awareness, particularly in SME's, have until now been a barrier to the wide spread take-up of this technology. But the picture is changing. The cost of multimedia technology is expected to fall steadily, and the range of options is broadening. The newer low cost technologies have attracted a number of major software suppliers to enter the market and the cost of producing and purchasing multimedia distance learning applications is now also starting to fall.

It is in the context of the need for skills development, the proven effectiveness of multimedia distance learning, and the expanding range of commercially available hardware and software, that this report examines the technology options and the policy issues surrounding the wider use of multimedia distance learning techniques, particularly with regard to SME's and remote areas.

# Chapter 2. Functional Requirements

## 2.1 THE MULTIMEDIA SKILLS EVALUATION FRAMEWORK

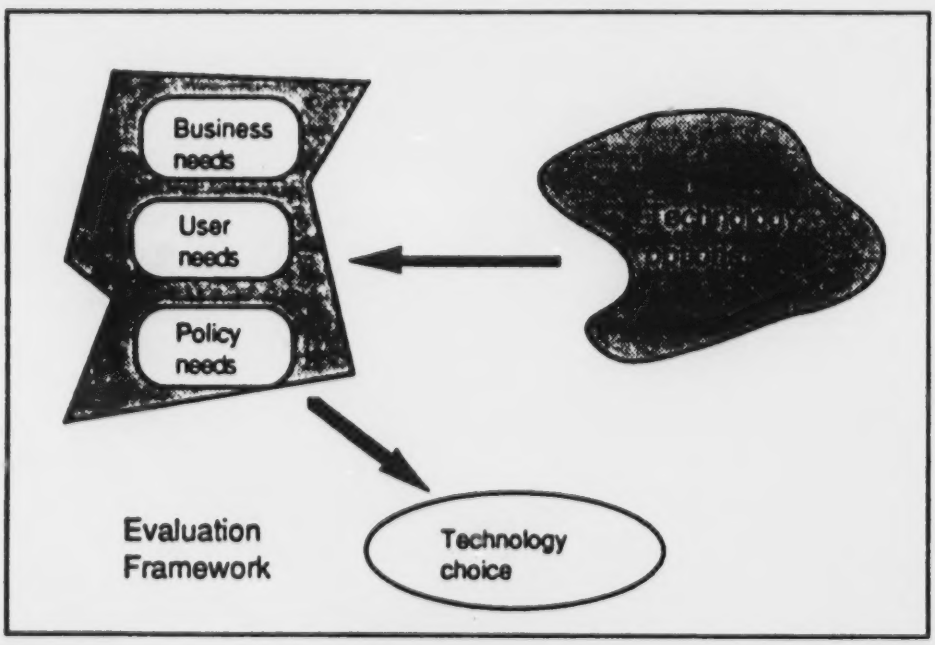
In the early years of computing many organisations spent a great amount of money on systems which never achieved their intended purpose. Although some of the failures can be attributed to software not working, a major cause was the lack of understanding by the management as to what computers could and could not do. In particular, many organisations failed to manage the technological change.

There are many issues surrounding the management of technological change, but one of the earliest steps is to specify the requirements for any new system before embarking on the evaluation of likely options. Selecting the 'best' option for a particular purpose requires a framework within which those options can be evaluated.

**An evaluation framework must address the needs of all interested parties if it is to be useful for the purpose of evaluating the options. In the case of distance learning, the parties are:**

- **the organisation which has the training need**
- **the learners who will use the systems**
- **the policy makers who are addressing the wider issues of skills shortages**

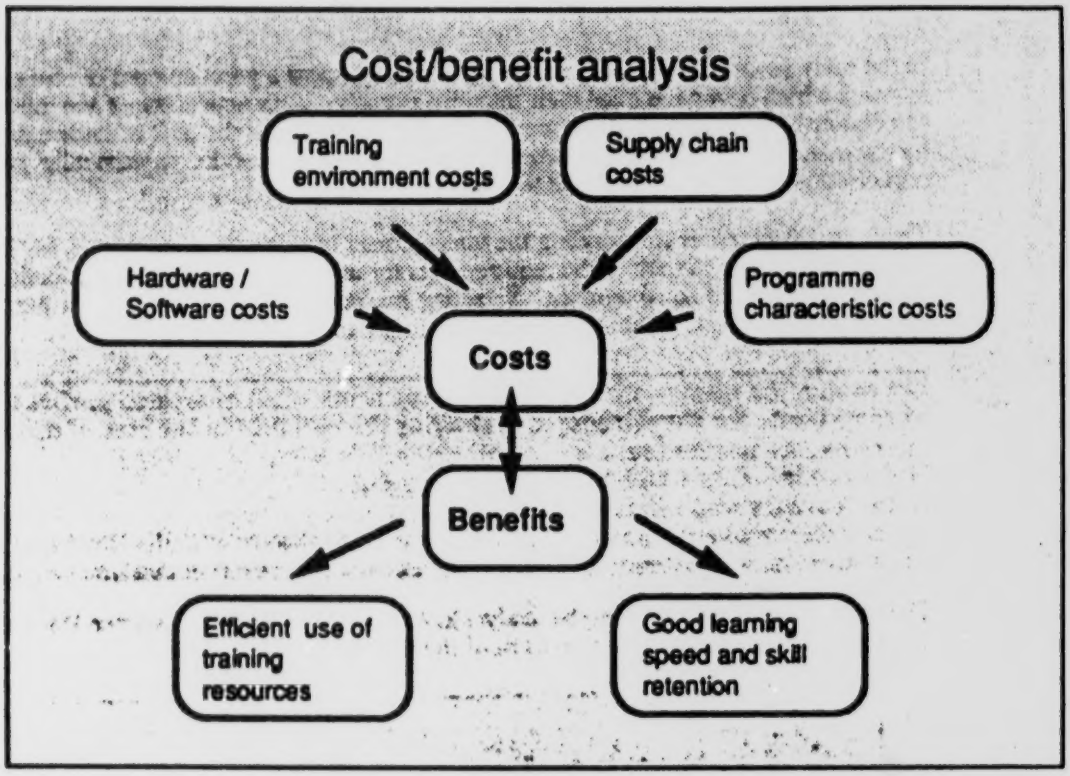
The framework needs to allow the analyst to evaluate how well the distance learning system 'functions' with respect to each of the parties' requirements.



Before looking at the technology options we will therefore examine the elements of a functional requirements framework against which these options could be evaluated.

## 2.2 BUSINESS NEEDS

Business needs for the application of technology to any operation can be summarised in terms of the cost and benefits analysis.




The direct costs of a system are important in any buying decision and so is the maturity of the technology and the cost trends. The maturity of the technology is an indication of the possibility of technical problems appearing, and also of the rate of innovation of new products. The more mature the technology, the less likely hidden costs are going to be under-estimated. The cost trends are important for determining if a technology which may be too expensive at the moment can be experimented with knowing that the cost will fall in the near future.

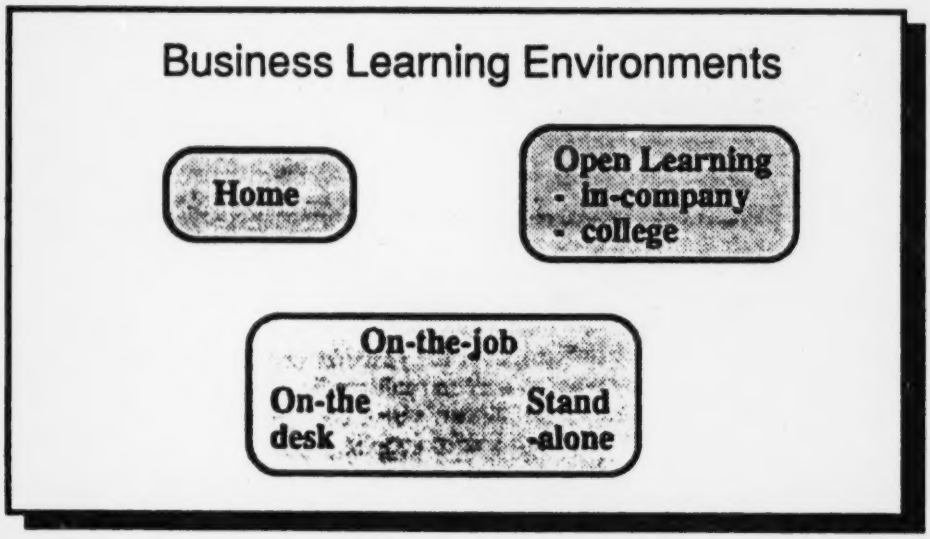
Aside from the direct costs, the hidden costs derive from three main elements:

- how well does the system fit into the business environment?
- what level of support exists for the system?
- how well does the software meet business needs?

The benefits are measured in terms of the efficiency of use of training time and budgets, and the effectiveness of the training in terms of time to learn and skill retention.

### 2.2.1 business environment

The distance learning system needs to fit in with business activities. These business activities may change as a result of embracing the distance learning techniques and technologies, but the system still has to fit in with the new way of doing things.




If the learners normally use a multimedia workstation on their desk, then the training can be integrated into their day to day working environment. Although this is not very common at the moment, there are an increasing number of multimedia workstations being supplied for operational use, and therefore the opportunity for this type of distance learning is growing. For example, travel agents in the US are now supplied by a major computer reservation system operator (WORLDSPAN) with multimedia terminals to connect to the reservation systems, rather than the simple terminals used in the past.

For people who do not normally use a multimedia computer, it is possible to provide a learning 'station' near to the place of work for shared use by the workers at that location. Currently, most on-the-job multimedia training is delivered this way. For example, banks and building societies, computer and car dealers, retail stores and others, are among the organisations providing such stand-alone learning stations at the place of work.

Where it is not convenient or economic to provide equipment at the place of work, open learning centres have been set up by organisations, often integrated with conventional training facilities, to house the multimedia workstations. These may be private to the organisation, or independent learning centres. For example, a major secretarial services company uses multimedia to regularly enhance the skills of their pool of freelance workers at a number of training locations.

As interactive multimedia systems move into the home, companies may find it very effective to provide distance learning programmes for their employees which can be used at home as well as at work. Broadcast television, and video and audio tape, are already widely used in addition to paper based materials for distance education at home. Interactive multimedia products are already available and programmes are being developed for them.

### 2.2.2 level of support

For a business to decide to use interactive multimedia training, it needs to look carefully at the levels of support in a number of areas. The questions to be answered are:

- how easy is it to buy the hardware and software?
- how well can local suppliers support these items?
- what user and developer experience exists locally?
- what software tools exist for programme development?

### 2.2.3 hardware and software availability

It has proven remarkably difficult over the years for organisations to buy multimedia systems. The buyer may want to order a multimedia system from a single source. But since the systems are a mixture of audio / visual and computer equipment, often linked by a computer plug-in board from a third supplier, systems integration is mandatory. This problem has been solved in some countries, but remains in many others.

Similarly, few organisations can afford to pay the full development cost of special programmes for their own use. Most will want to buy off-the-shelf published material. There are relatively few published programmes outside of personal computer skills training. These are published by a small number of specialist companies and are mostly in the English language. This is slowly changing as traditional large publishers start to see the demand building up, and the technology appearing in large enough numbers to justify the investment in interactive programmes.

### 2.2.4 support

Having acquired a system it is equally, if not more important, that support for the system is reasonably accessible. This applies to hardware failures, but perhaps more importantly, to software not doing what is expected. To make an investment in multimedia training, an organisation needs to see an organisation capable of providing hardware and software support for the systems.

### 2.2.5 user and developer experience

Few businesses are willing to be the first to try a new technology. The existence of an accessible body of user experience is a factor to be taken into account in choosing a system. For companies wishing to commission or develop their own programmes, it is also important to find a body of people experienced in the creation of multimedia distance learning programmes. Whilst the number of experienced designers and developers in the European Community is growing it is still relatively small.

### 2.2.6 authoring tools

Even if there is an adequate number of designers of interactive materials, they will be very unproductive if the software tools do not exist which allow them to implement the designs without needing professional computer programmers. The computer programs specially provided for developing and creating training applications are known as authoring tools.

### 2.2.7 business software needs

As well as the need for a programme to achieve its training objectives, there are a number of functional requirements the training software should meet to satisfy business needs.

**The characteristics of software meeting business functional needs are that it should :**

- **run on multiple hardware platforms conforming to any appropriate standards that exist**
- **be easy to update to keep up with changing requirement**
- **allow monitoring and assessment of student performance**
- **for remote areas, be able to be downloaded either over television, radio or telecommunications networks**

### 2.2.8 cross platform

There is a very strong trend in personal computing towards the use of a fairly standardised way of interacting with software known as graphical user interfaces. These are based on the idea that seeing and positioning is easier than remembering and typing. Thus the users respond to questions and select actions to be performed by 'pointing' to an object on the screen rather than typing a message on a keyboard. Many multimedia training programmes already use graphical user interfaces in order to avoid reducing their acceptance by introducing the keyboard unnecessarily into the training process.

However there is another significant advantage of the trend towards graphical user interfaces. The aim is to make software run on any system conforming to certain standards, or at least to make the adjustments necessary for different hardware platforms as small as possible. The objects which appear on the screen are intended to be similar for any hardware platform, although the details of how they are put on the screen differ for each system. However, the application only has to deal with the screen based objects and does need to be concerned how they are being managed, and should therefore be able to run on any platform supporting the objects required.

Similar techniques can be used to ensure that interactive multimedia programmes are also reasonably independent of the hardware on which they are running. Graphics, text and sound are available in a similar form on most multimedia systems, and so long as facilities exist for displaying the objects on the screen or playing the sound it does not matter to the application how they are encoded or stored.

As long as the multimedia system provides facilities for displaying moving video sequences on the screen, using the object oriented graphical user interface techniques will allow an application to show the video sequence regardless of the way it is encoded or the medium it is stored on. Authoring systems are now appearing which make use of these standardised graphical user interfaces and object oriented techniques to create programmes which will run on a number of different hardware platforms.

### 2.2.9 ease of updating

To make the best use of training materials facilities need to be provided to easily update and adapt the programmes to changing business needs. The rate of change of technology and the need for organisations to continually update and improve products and services implies the need for continual training and retraining of staff.

In many cases this will simply mean updating existing training materials to reflect the changes. This needs to be easily achieved or the training will be become obsolete as product and procedures manuals have in the past.

## 2.3 USER NEEDS

The user needs can be summarised by four main questions:

- **how easy is it to learn to use?**
- **how many styles of interaction are available?**
- **what devices are available for interacting with the system?**
- **what presentation media mix is available?**

### 2.3.1 ease of use

The first requirement from the user is that the system, the hardware and software, is easy to use. Among other things, this involves both the the method of interaction with the programme and the way in which the user proceeds from part to part. Standard forms of interacting with a system and a standard 'look and feel' help considerably in making programmes easy to use. A consistent user interface gives a feeling of confidence to the learner and makes it easier to use the 'next' programme. With the trend towards graphical user interfaces, a consistent look and feel environment is being established which will help to create a consistent, easy to use, interface to any programme conforming to its standards.

### 2.3.2 learning styles

To achieve its full training potential a multimedia programme should offer different learning styles to accommodate people's different personalities and the varying needs of the training material. Learners may respond badly to a training programme if it favours a particular style of presentation which does not suit them or the subject being presented. Fortunately, one of the unique strengths of interactive multimedia is its potential to offer the same material in a variety of different ways to suit varying needs.

Multimedia can offer simple didactic drill and practice style presentations suitable for some product knowledge and technical skills training. It can offer simulation for a variety of experience based needs such as interpersonal skills and more complex technical skills. It can offer exploratory techniques to allow browsing of knowledge bases. It can also offer analytical styles of training for problem solving applications such as equipment maintenance and fault diagnosis.

### 2.3.3 user interaction

A wide range of user input devices should also be offered to provide the user with appropriate interaction possibilities depending on the application. Voice input is clearly a very desirable technique, but unfortunately is only available for a very limited vocabulary at present. However it can replace a mouse as the pointing device and this can be useful for some applications. Direct pointing at a screen to select a response is perhaps the next most natural way of interacting with the programme. Any initial hesitation in touching the screen has been shown to rapidly disappear once learners get used to it.

Indirect pointing using a mouse or other similar device such as roller ball or joystick, to move a cursor on the screen is the most widely used technique of interaction with graphical user interface based materials. It is not difficult for most people to learn to use the mouse, but improper screen design can make it difficult for people with motor difficulties to place the cursor accurately on the screen. The least 'friendly' device for learner interaction is the keyboard. Although most young people now have some familiarity with keyboards it is still for many people a great inconvenience to have to type to interact with training programme.

### 2.3.4 presentation facilities

Multimedia allows information to be presented to learners in the way which is most appropriate for their particular needs at the time. The right mix of still and motion video, audio, still and animated graphics, and text can markedly improve the efficiency and effectiveness of the programme. Not all media are necessary or appropriate for all applications. Although a picture of a pump is pretty for example, a graphical diagram, probably animated at appropriate times, will much better explain the workings of it.

## 2.4 POLICY NEEDS

The policy needs can be summarised by three main questions:

- **what outputs of the present Community programmes are relevant to determining the functional requirements for the use of technology in distance learning?**
- **how can can these outputs be incorporated in a detailed needs analysis?**
- **what form of future co-ordination can help determine the functional requirements?**

### 2.4.1 community programme outputs

As identified in the Commission Staff Working Paper on Distance Education and Training (7 March 1990), the Commission has given substantial support to many co-operative programmes in distance education and open learning.

To avoid duplication of effort, as much of the relevant outputs from these programmes as possible should be incorporated into the analysis of the functional requirements for distance learning technology.

### 2.4.2 future co-ordination

Where appropriate, future work in other programmes should be co-ordinated with the analysis work on the technical options.

## 2.5 THE OUTLINE EVALUATION FRAMEWORK

The outline evaluation framework is based on the discussions in this chapter. It highlights the range of business and user requirements and summarises under a number of headings which will be used in chapter 3 for an outline evaluation of the strengths and weaknesses of the various technology options for multimedia distance learning.

It is however only a framework and it is necessary for a detailed needs analysis to be undertaken before a concrete evaluation of the various options can be made.

### Business needs

costs:
- maturity: a measure of likely hidden costs
- cost trends: a measure of future costs for the technology

support:
- number of suppliers: also the strength of the distribution and service industry supporting those suppliers
- number of published distance learning packages

user and developer experience
- number of users
- number of developers
- number and quality of authoring tools

software characteristics
- cross platform: the ability of software to run on more than one platform
- ease of updating
- monitoring and assessment of student performance
- downloading: important for remote areas

### User needs

- motion video
- touch screen : the most direct interaction
- pointing devices : mouse, joystick, roller ball etc
- keyboard : the most ubiquitous, but often least 'friendly' interaction
- voice control : most natural interaction, but not yet generally possible
- image resizing : the basic need for operation in a 'windowing' system

# Chapter 3. Summary of technologies

## 3.1 OVERVIEW

The technology options available for implementing distance learning are presented in this chapter.

The first section examines the personal computers commonly used in business It provides an analysis of each option and identifies the main suppliers. It is shown that any of the common platforms can support multimedia and that the choice of platform is not primarily a technological issue. Other factors are more important.

The second sections examines the multimedia extensions available for these personal computers and groups them according to the features offered. It examines the advantages with respect to multimedia and the main supporters of each technology.

The third section examines integrated solutions, primarily targeted at the consumer market. These low cost systems extend the reach of multimedia interactive training into the home. They are not based on the common business personal computers, although business personal computer like configurations are available for some of them.

The fourth section examines the role of telecommunications in enhancing multimedia distance learning. Although the technology is essentially free standing, the ability to access other information and electronic facilities can be important in some applications and environments.

The fifth section examines the process of creating multimedia training programmes. This process is called authoring and there are many approaches.

The sixth section examines the strength and weaknesses of the various options with respect to the outline framework established in chapter 2.

## 3.2 THE PERSONAL COMPUTER PLATFORMS

This section of the report looks at personal computer platforms individually, but the rest of this chapter deals with them as a group, since the issues surrounding the choice of multimedia systems are becoming independent of the personal computer chosen. There are indeed issues of supply and support, but these can only be dealt with on a regional basis, and issues of cost and of corporate culture can only be dealt with at the corporate level. In the Europe wide context of this report, we focus on the multimedia options and not the basic computer platforms.



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**Any of the personal computer platforms widely used in business will support the multimedia options:**

- **IBM and compatibles**
- **Apple**
- **Unix workstations**
- **others, Commodore, Acorn, NeXT etc**

The trend identified in chapter 2 towards similar graphical user interfaces across the main computer and operating system options, is already visible in its effect on the multimedia environment. Plug-in cards developed for one platform are being produced in versions that will operate on most of the others, and software packages developed in the well established Apple environment for example, are being made to run on the IBM and Unix platforms with their similar facilities.

From the applications point of view it is not the hardware itself, but the operating system that provides the look and feel of the systems. In the IBM world the two operating system environments are MS-DOS and OS/2. In the Apple world it is Apple OS, and in the work station world it is Unix. All of these operating system environments support a common graphical user interface concept, and although different in many details, the general way of using these is similar.

Since the IBM and compatible personal computers dominate the business market, and since the present differences in operating environments are being reduced, it is possible to simplify the analysis of the technology options by grouping all the PC platforms together and focussing instead on the differences in support for the multimedia elements of the technology.

### 3.2.1 IBM and compatibles

| | |
|---|---|
| **Description** | • IBM PC-AT plus myriad clones running MS-DOS<br>• IBM PS/2 |
| **Advantages** | • AT-type machines are the majority of business PCs<br>• windows graphical user interface for MS-DOS<br>• presentation Manager OS/2 graphical user interface |
| **Disadvantages** | • graphical user interface relatively recent<br>• not many GUI software packages as yet |
| **Supporting companies** | • IBM, and most other personal computer suppliers<br>• either directly as clones, or via plug-in MS-DOS card |
| **Linkages to other standards** | • it is the de-facto business computer standard |
| **Timescales** | • MS-DOS since the early 80s<br>• OS/2 since the late 80s<br>• windows since the late 80s |

The IBM personal computer range and its compatible clones have by far the biggest share of the corporate personal computer market. They also account for the great majority of interactive multimedia work stations installed in the distance learning field.

The IBM PC's used for multimedia operate on two main standards, the original PC-AT standard, and the newer PS/2 MCA standard. These standards determine how the multimedia plug-in cards required for these computers need to be designed. From the users point of view there is little to choose between them. The quality of image on the screen does not depend directly on which standard the system is using.

The PC clones generally operate on the older AT standard, but the most widely used multimedia plug-in cards are available for either system, as are the optical disc devices. It is not possible within the scope of this report to attempt to analyse all the clones on the market. Nor, as shown above, is it necessary. The choice of which IBM or compatible personal computer platform to use for multimedia applications is not constrained by the multimedia add-on elements themselves. The basic choice of a platform to run the applications will be determined by other factors, such as price, availability, support, corporate culture, and so on.

### 3.2.2 Apple

| | |
|---|---|
| **Description** | • Macintosh established on desk top publishing market<br>• the original graphical user interface business computer |
| **Advantages** | • easy to learn and use graphical user interface<br>• good and growing range of multimedia software<br>• very good integration between various applications |
| **Disadvantages** | • low penetration of business users<br>• comparatively high cost<br>• until recently little integrated motion video capability |
| **Supporting companies** | • Apple |
| **Linkages to other standards** | • Unix-like system also supported |
| **Timescales** | • since early 80s |

Apple has led the business computing world into the area of graphical user interfaces. The Apple Macintosh computer range has enabled the development of the desk top publishing market with its easy to use standardised graphical operating environment. This same ease of use has also encouraged the developments of the most sophisticated multimedia authoring tools. The highly integrated nature of the system allows various applications to transfer information more easily than the IBM related world.

However in the world of moving video based multimedia, the Mac has not been well integrated until recently. The video images had to be shown on a separate screen from the computer graphics. In the last year or two, a number of plug-in boards have been released which allow video from television, tape or disc sources to be digitised and mixed with graphics, text and sound to create full multimedia platforms on the Mac.

The ease of use of the Mac environment has been offset in the multimedia distance learning environment by the lack of integrated moving video facilities and the high cost of the systems. This has changed recently, but so has the unique advantage of the graphical user interface. With the release of Windows 3 on the IBM MS-DOS environment and Presentation Manager on OS/2, the advantages of the graphical user interface are now available on that platform as well.

### 3.2.3 Unix Workstations

| | |
|---|---|
| **Description** | • multitasking high resolution workstations<br>• primarily in engineering applications |
| **Advantages** | • public domain X-Windows graphical user interface support with two standard interfaces, Open Look and Motif |
| **Disadvantages** | • high cost of workstations, but coming down in price |
| **Supporting companies** | • Sun and AT&T with Open Look<br>• Open Software foundation with Motif (200 members worldwide including IBM, DEC, HP) |
| **Linkages to other standards** | • motif to Windows and Presentation Manager |
| **Timescales** | • late 1980s for Open Look and Motif<br>• X-Windows, early 80s |

The high end graphical workstation market is dominated by products running the Unix operating system. With the recent development of X-Windows based graphical user interfaces and plug-in video processing boards, these systems are also entering the multimedia field. The X-Windows standard is a publicly held standard and many workstation suppliers have embraced it and produced graphical user interfaces with similar capabilities to the Apple and IBM environments.

At the moment these systems are mostly confined to engineering applications where the large screens and extra processing power are used to good effect. As prices come down these systems are starting to be used in more general business applications.

The trend to porting authoring systems to other graphical user interface platforms can also be seen in operation in the Unix environment. Authoring systems using the graphical user interface and video processing cards are appearing on the market.

### 3.2.4 Others

| | |
|---|---|
| **Description** | • specialised personal computers derived from home market or high end specialists such as NeXT Dimension<br>• running proprietary graphical user interface systems |
| **Advantages** | • generally low or very high cost |
| **Disadvantages** | • special systems to learn<br>• incompatible with common business PC's<br>• very low penetration into business world |
| **Supporting companies** | • Commodore, Acorn, others |
| **Linkages to other standards** | • plug-in MS-DOS cards for running PC applications |
| **Timescales** | • middle to late 80s |

There are a number of personal computer systems which operate in specialist niches of one sort or another. Two which bridge the home / games to business market are the Commodore Amiga and the Acorn Archimedes systems. These are both low cost systems with all the appropriate add-in cards for multimedia, and both operate with graphical user interfaces.

Both systems have been used in distance learning applications and both have a reasonable authoring environment. Although their penetration into the business market is quite low, they are none-the-less very capable platforms for multimedia applications. Indeed both systems have very good graphics capabilities derived from innate processing power and the home games background.

CD-I is also available in a personal computer form, but it is not relevant in the context of the general computer platforms, since even in its 'professional' form it does not at the moment offer software for general business computing applications.

At the other end of the price scale, the NeXT Dimension computer systems offer a very high specification graphical user interface based multimedia platform competing with the Unix work stations, and top end Apple and IBM platforms.

There are a number of other platforms, but they have a very small market share in the multimedia distance learning field and do not need to be mentioned explicitly here.

## 3.3 MULTIMEDIA OPTIONS

### Overview

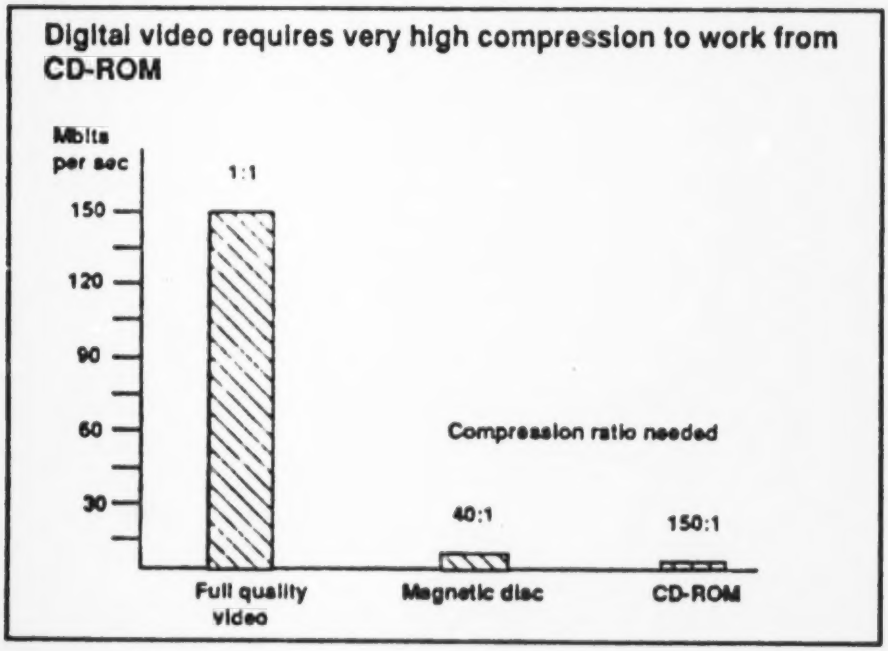
Using the simplifying assumptions presented in the previous section the analysis of technical options can focus on the multimedia elements to be added to the basic personal computer platform. The six analysis categories shown below are not based on any quality criteria. They are simply groups of multimedia capabilities. The first group of four offer digital audio and image facilities, the fifth offers analogue video capabilities and the sixth offers digital processing of analogue video source materials.

**The multimedia capabilities that can be added to a basic PC can be categorised as follows:**

- **PC + digital audio**
- **PC + CD-ROM**
- **PC + CD-ROM + digital audio**
- **PC + CD-ROM + image encoding + digital audio**
- **PC + Analogue video: video tape, videodisc**
- **PC + Analogue video + digital processing**

Some of the options can of course be used in combination in a single PC, but not all of them are compatible. For example, digital audio can be added to a PC with analogue video to provide an alternate sound source. The choice of which options to use depends on the application and other considerations such as cost , user and producer experience, and availability

It is not the intention of this report to examine all the individual multimedia options in detail, but to give an overview of the options with respect to their ability to meet the functional requirements detailed in the previous chapter.



### 3.3.1 PC + digital audio

| | |
|---|---|
| **Description** | • digital audio plug-in cards |
| **Advantages** | • add computer stored sound to graphics |
| **Disadvantages** | • limited sound storage capacity |
| **Supporting companies** | • many |
| **Linkages to other standards** | • some use of audio industry digital standards |
| **Timescales** | • mid 80s |

Although not providing a full multimedia capability, the simple addition of a digital audio card to a standard PC and has been shown to achieve some of the efficiency and effectiveness advantages of full interactive moving video based distance learning applications.

Digital audio cards allow the recording on a computer disc of digitised audio signals, their editing via software, and playback as required through speakers or headphones.

### 3.3.2 PC + CD-ROM

| | |
|---|---|
| **Description** | • compact disc players capable of storing computer graphics and text information as well as CD-Audio sound |
| **Advantages** | • large storage capacity at low cost<br>• CD-audio straight from player |
| **Disadvantages** | • no moving video capability<br>• only sound or data at one time |
| **Supporting companies** | • Philips, Sony and most CD-audio suppliers,<br>• Apple, IBM and most personal computer suppliers |
| **Linkages to other standards** | • ISO 9660 is the standard for CD-ROM |
| **Timescales** | • late 80s |

The CD-ROM offers a low cost, large capacity storage device for multimedia applications. Like digital audio cards, a CD-ROM by itself offers only audio in addition to normal PC capabilities. However the large capacity for data, and the ability to play CD-Audio sound direct to a loud speaker from the CD-ROM device without involving an audio card in the computer make it an ideal publishing medium for programmes that only need the limited multimedia capability separate audio adds.

The CD-ROM cannot be used for data transfer to the computer while it is playing audio, so the flexibility of programme design is somewhat limited, since any graphics or text information needs to be transferred to the PC prior to playing the audio. The CD-ROM standard defines how data should be stored on the compact disc, but does not allow interleaving of different data types, although the digital data stream can be interpreted as audio of course if the application decodes it and sends the information to a digital audio card.

### 3.3.3 PC + CD-ROM + digital audio: CD-ROM-XA

| | |
|---|---|
| **Description** | • interleaved recording of sound and graphics for computers |
| **Advantages** | • international standard<br>• still and motion video standards expected soon |
| **Disadvantages** | • no video standards as yet |
| **Supporting companies** | • Philips, Sony, others in development |
| **Linkages to other standards** | • subset of CD-I |
| **Timescales** | • late 80s |

CD-ROM-XA provides a standard definition for audio and graphical information to be interleaved on a compact disc. The standard is being extended to cover how information should be arranged on the disc to allow stills and motion video to be stored digitally and played back as well.

The system provides greater flexibility for the multimedia author to mix sound and graphics together than the standard CD-ROM format. But until image handling is added it still only offers a limited multimedia capability. Philips and Sony have both released CD-ROM-XA products, and other manufacturers are expected to follow suit shortly.

It is also possible to simply interpret the data stream from a normal CD-ROM as sound a play it through a digital audio card in the computer, but the XA standard makes this an unattractive option once XA systems are well established.

### 3.3.4 PC + CD-ROM + image encoding, e.g. DVI, C-CUBE

| | |
|---|---|
| **Description** | • digital compression of full screen full motion video<br>• digital audio encoding |
| **Advantages** | • no analogue technologies required<br>• image manipulation capabilities |
| **Disadvantages** | • low quality images if played from CD-ROM<br>• high cost encoding compared with analogue video |
| **Supporting companies** | • Intel, C-Cube, others including IBM |
| **Linkages to other standards** | • MPEG, JPEG |
| **Timescales** | • now |

The basic problem with digital moving video is the very high data rate needed for full screen full motion video. Some form of image data reduction is needed to allow video to be played from digital storage devices and displayed on a computer screen. The International Standards Organisation has defined a standard for compressing still images (JPEG) and C-Cube has developed a chip which compresses motion video to JPEG standards in real-time, as it is being recorded or played back. However the data rate is still too high to work with standard compact disc for full screen full motion video. A further standard for compressing motion video (MPEG) which can run from compact disc, has been announced, and a number of manufacturers are looking at producing chips which conform to these standards.

However, at present, the only widely available commercial system that can compress full screen full motion video sufficiently for it to be stored and played back from a compact disc is DVI. The very high compression ratios achieved with the current DVI chips mean that some quality loss in the moving images is unavoidable. However for many distance learning applications the lower quality full screen or good quality partial screen moving image is more than adequate.

For DVI to achieve the best moving image quality it is necessary to have the images processed separately from the personal computer. It is not a real time image encoding and display system at the best quality. However, at a lower quality, real-time recording and playback is supported.

The CD-I and DVI suppliers have stated an intention to support the MPEG standard and other suppliers have also announced that they will develop chip sets or products supporting it.

### 3.3.5 PC + Analogue video: video tape, videodisc, e.g. IVA

| | |
|---|---|
| **Description** | • videodisc player and overlay card |
| **Advantages** | • fast, good quality video, easy to create master tape<br>• video production supported by television industry<br>• numerous authoring packages |
| **Disadvantages** | • equipment and video production costs<br>• different NTSC and PAL television standards |
| **Supporting companies** | • Philips, Sony, Pioneer: players<br>• Videologic (IVA) and others: overlay cards |
| **Linkages to other standards** | • Laservision is a world standard |
| **Timescales** | • early 80s |

The earliest and most widely used multimedia add-on is the analogue videodisc player, and its associated computer overlay/mixing plug-in card. The most commonly used standard is the Laservision format, although other formats do exist. Videodisc devices store the video and audio signals in their original analogue format, they do not digitise the information. For this reason they are able to play video and audio signals together, just as television does, without any picture quality loss due to computer processing of the signals.

Videodiscs are to video tape what records are to audio tape. The original video and audio electrical analogue signals are stored on the disc and played back as required in the same format. The computer mixes graphical and text information with the original video image using a special add-on card and shows it on the one screen. The video images cannot be moved or resized by these systems, they are simply passed through to the display system in their original size.

There are numerous systems on the market. The videodisc players are supplied primarily by Philips, Sony and Pioneer in Europe. There are also a number of overlay card suppliers, but in Europe the main supplier is Videologic with its IVA series of plug-in cards. Other suppliers are listed in the Annex. Since it is a recorded medium Laservision is not a real-time system. Videotape is clearly recordable, but has been little used as an interactive multimedia solution for distance learning due to the lengthy time delays while the player searches for video sequences. Recordable videodiscs do allow real-time operation but their cost is very high and again little application has been found for them in the delivery of distance learning.

### 3.3.6 PC + Analogue video + digital processing, e.g. DVA, M-Motion

| | |
|---|---|
| **Description** | • real-time digitisation and image manipulation of analogue video and audio sources |
| **Advantages** | • analogue picture quality with digital processing flexibility<br>• integration across platforms into graphical user interfaces<br>• minimises PAL / NTSC standards problem |
| **Disadvantages** | • cost |
| **Supporting companies** | • Videologic (DVA), IBM (M-Motion), others |
| **Linkages to other standards** | • PAL NTSC SECAM television standards<br>• MPEG, JPEG support coming |
| **Timescales** | • now |

To provide the flexibility of digital images with the quality of analogue video a range of add-on cards for PC's have been developed which digitise the analogue image in real-time at full digital image quality. The resulting digital image is available for mixing with computer generated graphics and text, and for resizing and other video effects. The original signal can come from any analogue source such as broadcast television, videodisc, videotape, video camera etc. Until digital compression technology improves, high quality full screen full motion video will continue to rely on analogue video sources.

In their simplest application, these cards allow existing videodisc distance learning packages to be run without change. Used in the graphical user interface environment, they allow moving video and sound to be used wherever text or graphics would otherwise be used in any computer application. It is this latter capability which opens up multimedia computing to the widest possible audience, due to the very large investment already made, and continuing to be made over the next few years in graphical user interface based software.



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The multi-platform market leader for interactive multimedia distance learning applications is the Videologic DVA card and software system, which runs on IBM, Apple and Unix systems. Other similar cards are available but usually specific to one platform. For example IBM's M-Motion card only runs in the IBM environment, and a number of Apple Mac cards are specific to that system. It is however to be expected that more cross platforms will soon appear, as new digital image processing chips are now emerging which reduce the costs considerably.

## 3.4 INTEGRATED SYSTEMS/CONSUMER PRODUCTS

The low cost high volume nature of consumer products leads to an alternative source for multimedia distance learning platforms. These systems do not have the flexibility of business computers but do have the advantage of low cost. Where it is not necessary to have the open nature of the business computer, these stand alone integrated systems have an interesting role to play in the distance learning field.

All these systems are intended to operate in the domestic environment using the standard television as the display device, and some sort of simple joystick or hand controller for user interaction. They comprise a single compact unit either in domestic videotape/hi fi packaging or even simpler games packaging. The CD-I and CD-TV systems are new products aimed at using CD-ROM as the storage device and using powerful graphics processing to provide entertaining animated graphics and, at the moment, partial screen motion video. They are both expected to be released with full screen MPEG encoded motion video in the next few years.

The well established home games systems from Nintendo and Sega do not at present have CD-ROM capabilities, but it can be expected that these will be added in a similar time frame, probably also with MPEG motion video encoding.

**A number of consumer products are or will be suitable interactive multimedia platforms for distance learning:**

- **CD-I**
- **CD-TV**
- **games machines: Nintendo, Sega, Fujitsu, NEC, Atari**

Although these systems are intended for the consumer market, their use in distance learning for business is appropriate where the cost of the delivery platforms is a prime consideration. In their packaged consumer versions these systems have no large recordable store and so distance learning applications have to run without the ability to update information. In any environment where compatibility with business computers is not required, these systems have a role to play.

It has been shown that games environments are very good for transferring otherwise uninteresting material. Product knowledge training has been very successfully carried out by creating games scenarios for the acquisition and testing of the knowledge. Staff have been known to stay after work to try to beat the system and prove they know the products completely.

Games will undoubtedly play a significant role in distance education in the home and many business skills training needs could well be met by these low cost systems.

Both CD-I and CDTV are also offered in personal computer versions which have the full range of peripherals expected of a business computer. These configurations allow authoring of the programmes for delivery if necessary on the integrated versions.

### 3.4.1 CD-I

| | |
|---|---|
| **Description** | • integrated sound, animated graphics, and image system developed for the consumer market |
| **Advantages** | • low cost<br>• international standard |
| **Disadvantages** | • no full screen full motion video as yet<br>• complex creation process |
| **Supporting companies** | • Philips, Sony, Matsushita |
| **Linkages to other standards** | • superset of CD-ROM-XA<br>• MPEG to come |
| **Timescales** | • now<br>• MPEG 1991+ |

Philips and Sony announced their intention to develop an interactive, multimedia system, aimed at the consumer and educational markets in early 1986, and Matsushita joined them later. This system, Compact Disc - Interactive, defines a number of digital audio and image standards, and integrates them together with an inbuilt set of custom developed audio visual processors.

The system has multichannel sound (mono or stereo), photo-quality still images, and excellent moving cartoon animation. Partial-screen moving video is possible, but requires an additional yet-to-be released video compression system (to be based on the MPEG standard) to handle full screen full motion video. The product has the support of Philips and Sony, as well as Matsushita (who own the National and Panasonic brand names).

### 3.4.2 CDTV

| | |
|---|---|
| **Description** | • based on Amiga computer with CD-ROM, packaged like a domestic videotape player |
| **Advantages** | • low cost<br>• existing Amiga software base |
| **Disadvantages** | • single supplier not well established in business market<br>• no full screen full motion video as yet |
| **Supporting companies** | • Commodore |
| **Linkages to other standards** | • CD-audio, CD-ROM ISO9660 but not fully compatible<br>• MPEG to come |
| **Timescales** | • now<br>• MPEG 1991+ |

Commodore Dynamic Total Vision is another option involving CD-ROM. This is a recent announcement by Commodore for a low cost multimedia environment based on their Amiga range of personal computers. Like CD-I it is a single unit comprising a proprietary computer system and built in CD-ROM drive. However, like CD-I, full screen full motion video will need a special processing card. Commodore is expected to base this this on the MPEG standard.

The Amiga is a well established personal computer and a considerable base of experience and expertise exists for the development of Amiga applications, but the CD-ROM is not compatible with the CD-I nor with the CD-ROM-XA standards.

### 3.4.3 Games machines

| | |
|---|---|
| **Description** | • low cost personal computer dedicated to games |
| **Advantages** | • low cost<br>• good games oriented graphics capabilities |
| **Disadvantages** | • no full motion video, limited sound |
| **Supporting companies** | • Nintendo, Sega, NEC, Fujitsu, Atari, others |
| **Linkages to other standards** | • MPEG to come |
| **Timescales** | • mid 80s<br>• MPEG 1991+ |

These games products do not use compact discs at the moment, but it is only a matter of time before they are added. Fujitsu's Towns system already has an optical disc but is at present only available in Japan.

These suppliers are developing add-ons to the basic games machines which for example allow home banking to be undertaken via a modem and software package. Other home applications are sure to follow.

With the enormous volumes of machines in the market and the low cost of the equipment, there is clearly a potential for these systems to provide distance learning applications. The arrival of low cost MPEG chips will undoubtedly allow these manufacturers to take advantage of the moving video capabilities for games and ultimately other applications.

## 3.5 TELECOMMUNICATIONS

### 3.5.1 interactive multimedia: the telecommunications component

Thus far interactive multimedia technologies have been highlighted from the point of view of local interaction without access to or from remote resources. Most of the interactive multimedia technologies will support, however, such remote access and can easily be integrated with telecommunications facilities, such as broadcast television, voice and data telecommunications.

It is emphasised that interactive multimedia and telecommunications are not exclusive but complement each other very well. Interactive multimedia is concerned with user interaction with information using various different media both from a representation point of view (video, graphics, sound as well as text and data) as well as from a storage and delivery point of view.

Many interactive multimedia technologies utilise optical disc as local storage devices since large volumes of digital and analogue data may have to be stored and moved around The choice of storing locally is a matter of costs, response times and the available infrastructure for delivering large amounts of data via networks. As the high bandwidth technologies for two way communications develop and become more commonly available, remote access to multimedia information will be used more regularly.

To add telecommunications to interactive multimedia offers a number of important advantages and new possibilities as will be explored below.

Also in situations where no optical storage is involved and telecommunications is the main method for information delivery, interactive multimedia plays a very significant role in defining and enabling easy user interaction with information.

### 3.5.2 broadcast television

The use of broadcast television, whether terrestrial or satellite, can be effective as a way of distributing interactive material to remote locations. Both the material and the computer software to control the interactive programme can be broadcast, compressed digitally and stored locally on magnetic disk or writable optical disc for subsequent use by students.

For learning centres with the appropriate computer network, this can be an alternative to obtaining published material. The information recorded locally can be accessed over a local area network or distributed by tape cartridge to interactive multimedia learning stations.

### 3.5.3 Datacommunications

**Datacommunications has the capability to considerably enhance multimedia distance learning. It can provide access to information not available at the learning station and it can also provide a technology based substitute for the personal interaction learners will still need from time to time**

With the advent of high speed local and wide area telecommunications networks, and the high compression rates achievable by the digital image technologies, it will be possible to send audio visual material over telecommunications channels in the same way as graphic and text data is now sent.

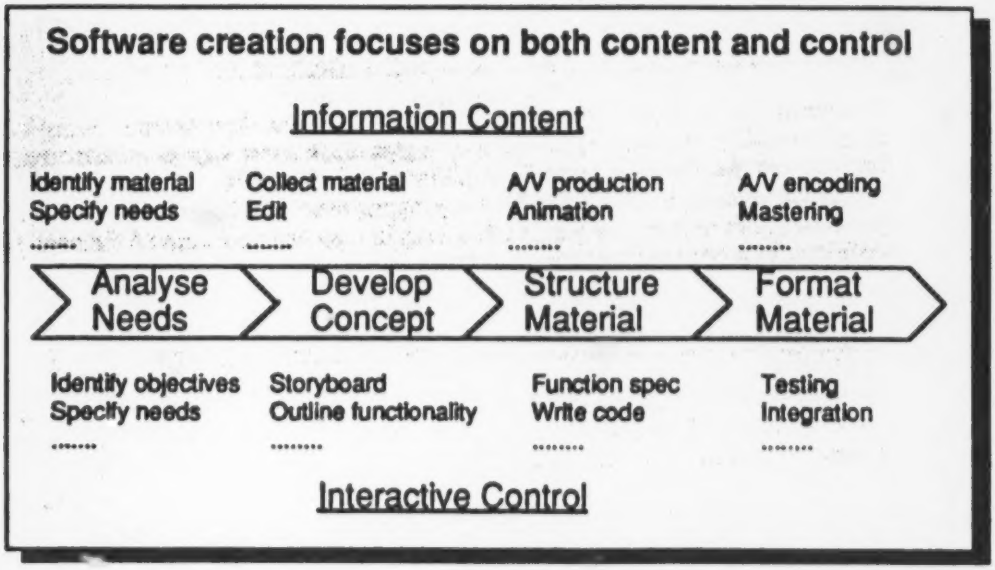
In any environment where centrally held information can be made available to distant locations, telecommunications can provide access to material not held locally, or not published on optical media for general distribution. This can substitute for a library in the conventional environment, providing access to a wider range of support material for the training needs.

Telecommunications is also important to distant learners for a another reason. The very isolation of the learners from the source of the training and indeed from support services, gives rise to a need for communication with these sources. Telecommunications offers one way of achieving this communication, and indeed can also offer a form of learner to learner communication.

The ability to leave questions for tutors or other students to answer via an electronic mail or messaging service can greatly enhance the efficiency of the learner. The ability to involve in electronic conferencing can also enhance the quality of the learning by substituting for the usual face to face discussions. Bulletin board services in the US has shown how effective such systems can be for distant support.

## 3.6 AUTHORING

Authoring concerns the efficient creation of the programmes for various hardware platforms. It is critical to the future success of any hardware platform.




A modern way of authoring is to use object oriented design and development techniques. In this way it is possible to separate the creation of the contents from the creation of the user interaction with those contents, i.e. the interactive control, needed for any particular application using those contents. By using these techniques to separate content and control, it is easier to produce multi-platform applications and to re-use the contents in other applications as required.

**At present there are three main groups of programme creation products:**

- **conventional computer programming languages**
- **programming language related authoring systems**
- **graphical user interface based authoring systems**

### 3.6.1 conventional computer programming languages

Any application that can be specified for distance learning can be programmed using conventional computer languages. Indeed many of the more sophisticated applications can only be implemented in this way. The problem is that programming is not particularly efficient for this purpose, and professional programmers are needed to use the more sophisticated languages typical of the multimedia environment.

### 3.6.2 programming language related authoring systems

To simplify the task of interactive videodisc programme development many 'authoring' languages and systems have developed. These all in some way or another reduce the flexibility of the designer, in order to allow non-professional programmers to implement training applications. These systems have not shown great productivity gains over conventional languages, but have in many cases removed the need for professional programmers to be involved.

### 3.6.3 graphical user interface based authoring systems

The most recent object oriented graphical user interface based authoring systems have shown considerable productivity gains over other forms of authoring, but again at the expense of flexibility in many cases. However it is to be expected that the sophistication of these products will continue to increase rapidly due to the emerging graphical user interface standards and the expanding multimedia corporate communications market which is many times larger than the interactive training market.

### 3.6.4 analogue and digital authoring costs

The creation of analogue audio and video material is supported by a very mature and enormous broadcast and corporate television industry. The assembling of a master tape with its special effects and other editing requirements can be undertaken at numerous locations in almost any large city in Europe, and in many other locations besides. The master tape then needs no further processing prior to the pressing of the videodisc, nor does the application programmer have to get involved in the details of the presentation of the audio and visual material.

Digital systems on the other hand have no such mature supporting industry. The creation of the multimedia master digital tape to be used for the pressing of a compact disc is a much more complicated process. In addition, the application creator has to be involved in the processing of the digital signals during the running of an application in order to recreate the original audio and visual signals and display them on a screen. This will undoubtedly change with time, but at the moment it is a significant factor against the wide spread take up of digital technologies in sophisticated distance learning applications.

## 3.7 STRENGTHS AND WEAKNESSES

The tables on the following pages refer to the outline framework given at the end of chapter 2. These represent a static picture of the present state of the art with respect to the platforms identified earlier in this chapter.

The first table looks at the relative costs of the platforms at present. It shows that the consumer packaged products are the low cost options, with the digital CD based products in the mid range and the Laservision based products at the high end of the range.

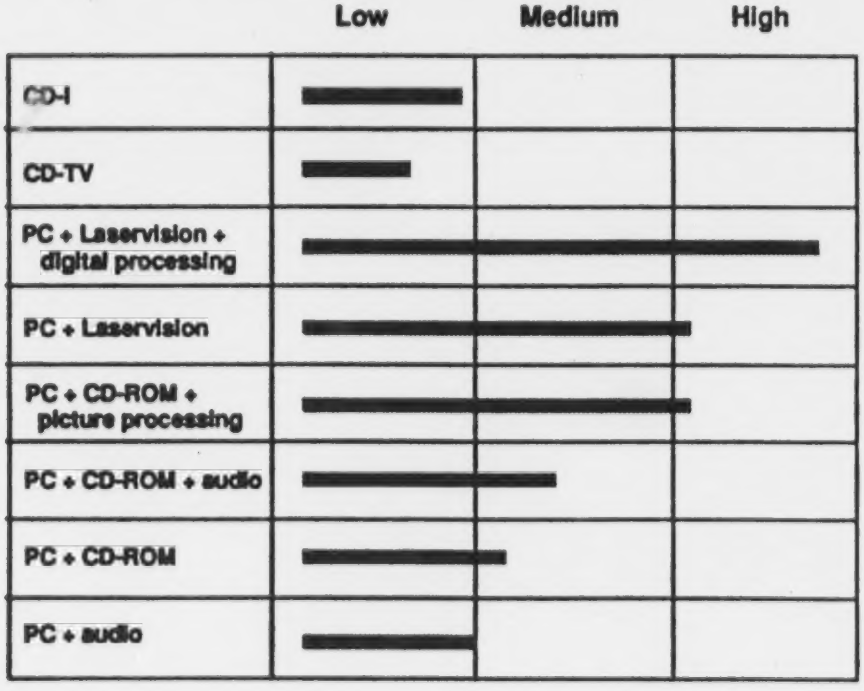
The second table looks at the maturity, cost trends and support issues, and shows the well established Laservision system as the most mature with the greatest support structure at this time.

The third table looks the business requirements and shows a very significant uniform ability to meet most of these for all the platforms.

The fourth table shows the dominant present position of Laservision in terms of published materials.

The fifth table shows that with the exception of motion video all the platforms provide the major user display and interaction requirements.

Currently, CD-I and CDTV are the low price options, with Laservision + digital processing at the high end



# Platforms rated against maturity and cost considerations

| | Maturity | Cost trends | Number of users | Number of developers | Authoring tools | Number of suppliers |
|---|---|---|---|---|---|---|
| CD-I | • | ↓ | • | • | • | • |
| CD-TV | • | ↓ | • | • | • | 1 |
| PC + Laservision + digital processing | ● | ↘ | • | ● | ● | ● |
| PC + Laservision | ⬤ | → | ⬤ | ⬤ | ⬤ | ● |
| PC + CD-ROM + picture processing | ● | ↘ | • | ● | ● | • |
| PC + CD-ROM + audio | ● | ↘ | • | • | • | • |
| PC + CD-ROM | ● | ↘ | • | ● | ● | ● |
| PC + audio | ● | ↘ | ● | ● | ● | ● |

Rating

- • low
- ● moderate
- ⬤ high

# Rating of platforms against software characteristics

| | Ease of updating | Cross platform | Monitor-ing | Down-loading | Ease of creating | Published packages |
|---|---|---|---|---|---|---|
| CD-I | • | - | ● | • | • | • |
| CD-TV | • | - | ● | • | • | • |
| PC + Laservision + digital processing | ● | ● | ● | ● | ● | ● |
| PC + Laservision | • | ● | ● | ● | ● | ● |
| PC + CD-ROM + picture processing | ● | • | ● | ● | ● | • |
| PC + CD-ROM + audio | ● | ● | ● | ● | ● | • |
| PC + CD-ROM | • | ● | ● | ● | ● | • |
| PC + audio | ● | ● | ● | ● | ● | ● |

Rating

- • low
- ● moderate
- ● high

# Published applications available for each platform

| | On the job -technical | On the job -interpersonal | Open learning | Training the trainers |
|---|---|---|---|---|
| CD-I | • | • | • | • |
| CD-TV | • | • | • | • |
| PC + Laservision + digital processing | ● | ● | ● | ● |
| PC + Laservision | ● | ● | ● | ● |
| PC + CD-ROM + picture processing | ● | ● | ● | • |
| PC + CD-ROM + audio | • | • | • | • |
| PC + CD-ROM | • | • | • | • |
| PC + audio | • | • | • | • |

Number of programmes

- • few
- ● moderate
- ● many

# Rating of platforms against user requirements

| | Motion video | Touch screen | Pointing devices | Keyboard | Voice control | Image resizing |
|---|---|---|---|---|---|---|
| CD-I | • | - | ● | • | - | • |
| CD-TV | • | - | ● | • | - | • |
| PC + Laservision + digital processing | ● | ● | ● | ● | • | ● |
| PC + Laservision | ● | ● | ● | ● | • | - |
| PC + CD-ROM + picture processing | ● | ● | ● | ● | • | ● |
| PC + CD-ROM + audio | - | ● | ● | ● | • | - |
| PC + CD-ROM | - | ● | ● | ● | • | - |
| PC + audio | - | ● | ● | ● | • | - |

Rating

- • low
- ● moderate
- ● high

## 3.8 CONCLUSIONS

- any of the personal computers in common use in business today will support the multimedia options of voice and sound, and still or moving images.
  - IBM and compatibles
  - Apple
  - Unix workstations
  - others, Commodore, Acorn etc
- although the Apple Macintosh presently provides the best range of graphical user interface (GUI) based multimedia programme creation software, the trend towards similar graphical user interfaces on all PCs will gradually reduce this advantage.
- the present majority of Laservision authoring systems and published training programs will diminish over the next two or three years as digital authoring systems and training programs become more available.
- the release of the consumer CD-I, CDTV and other low cost systems will open potential volume markets for publishers and give industry a low cost alternative to business personal computers for multimedia applications.
- the present trend towards GUI based multi-platform authoring and delivery software will be the key to low cost programme production.
- telecommunications has a significant role to play in the coming years with high bandwidth circuits capable of transmitting video in addition to other information, and the use of electronic conferencing to bring remote learners in touch with trainers and other learners.
- in the medium term, the emergence of digital encoding chips based on ISO standards, the development of similar graphical user interfaces for operating software and powerful authoring systems based on them, should provide a common software environment allowing distance learning programmes to be produced to run on the consumer low cost systems or business multimedia PCs with little change.

# Chapter 4. Two case studies

## 4.1 INTRODUCTION

The case studies are entirely hypothetical and are used to illustrate the multimedia distance learning environment in practice. The hardware described is all available today and similar software has already been developed in one form or another for these applications. So although the situations are hypothetical the technology exists now to implement these scenarios.

The other purpose of the case studies is to help identify the issues facing the Commission in establishing multimedia distance learning as an integral part of the training and retraining of the workforce. The advantages of interactive multimedia in helping to solve the skills gap situation are clear, and its ability to help to improve the productivity of training in Europe is also clear. But the widespread take up of the technology needs to be stimulated in the Community if it is going to achieve its potential.

Before looking at some example applications we examine the process of implementing a multimedia distance learning system into an organisation.

## 4.2 BUSINESS FACTORS

A number of large organisations have committed themselves to multimedia distance and open learning. However, there are many large, medium and small enterprises which have not yet been able to take advantage of this relatively new technology. This is not unique to multimedia distance learning. The process of new technology introduction and the management of technological change is a difficult, but moderately well understood one. The successful introduction of new technology generally depends on addressing each of the elements in the implementation process with due care and attention.

**The introduction of new technology into an organisation involves five major stages, all of which are critical to successful implementation:**

- **awareness and understanding**
- **strategy development**
- **preparation for organisational and operational changes**
- **introduction of the technology**
- **evaluation and progress to the next iteration**



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# Implementation scenario for business

**Awareness:** Making trainers and managers aware of the benefits and availability of multimedia distance learning

**Needs analysis:** Developing a strategy for the introduction of multimedia dealing with key business skills needs, make or buy cost benefit analysis, organisation and management, staff perceptions and awareness, learner support structure, equipment selection, and the environment for the learning stations

**Acquire programme:** A programme can be bought, rented, commissioned, or made in-house.

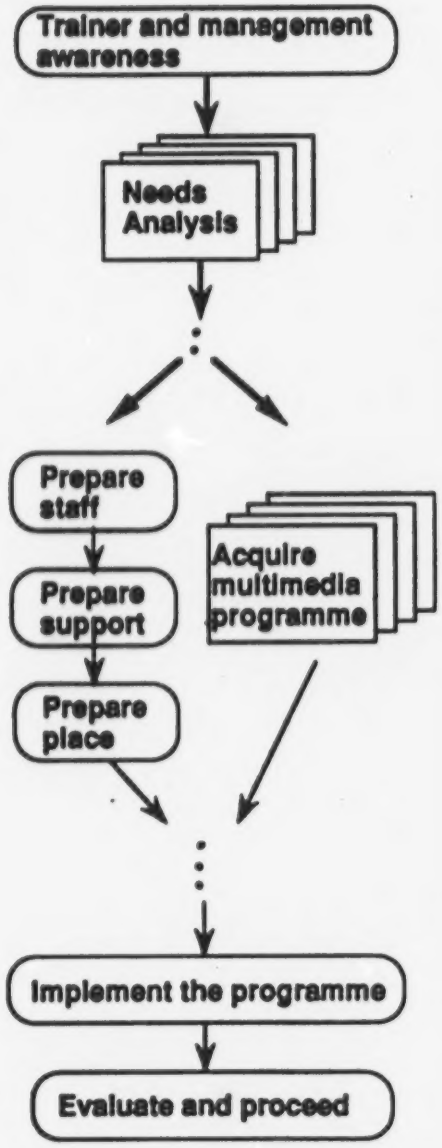
**Prepare staff:** Make sure everyone understands the concepts, role and benefits of multimedia distance learning

**Prepare support:** Determine the level of support needed and make sure it is in place before the programmes are introduced

**Prepare place:** Decide where the work stations are to be and create a suitable environment for learning

**Implement the programme:** install and start using the programme.

**Evaluate and proceed:** evaluate the effectiveness and efficiency of the application and proceed to the next application



### 4.2.1 awareness and understanding

The first, and often one of the most critical, stages of the process is the generation of awareness and understanding both at senior management level, and amongst the staff who will be responsible for the introduction of the new technology and those who are going to use it.

Although it is obviously important to demonstrate the capabilities and limitations of the technology and identify its advantages over present systems, it is also necessary to clearly identify the benefits to the business as well. By their nature organisations generally resist change, and unless a clear need *and* a clear benefit can be identified it is difficult to get real commitment to new technology.

But it is not only the management who need to be considered in this context. New technology will inevitably affect some aspects of their daily work, and perhaps the role, of a number of people in the organisation.

### 4.2.2 strategy development

There are many elements to the development of a strategy for the introduction of multimedia distance learning techniques and technologies. A training needs analysis will identify the skills development requirements and allow them to be considered in the context of the overall business aims and objectives. The role of distance learning in meeting those needs can then be established and a list of programmes to be implemented can be prepared. On the basis of this list a technology evaluation can then be carried out. This will include both hardware and software as described in the previous section.

Although the choice of a hardware platform is important, it is not considered a critical factor in the successful implementation of multimedia distance learning. It has been demonstrated that interactive multimedia training is effective on a wide range of equipment with a wide range of capabilities. What is critical, is the software.

For a large organisation, the equipment which best fits the already installed information technology environment will probably be easiest to introduce and support, but in a stand alone on-the-job environment, or in a distance learning centre, the availability, effectiveness and efficiency of the software will dominate the technology choice.

### 4.2.3 preparation for change

No matter how good the technology is, if the organisation is not prepared properly to exploit it, the productivity gains may not be realised. A critical factor for the successful use of multimedia for distance learning is the level of skill of the managers and trainers in the application of the technology.

Interactive multimedia has a major role to play in promoting itself. Programmes allowing users to explore and experience the range of training possibilities serve the dual purpose of expanding awareness of the opportunity, and training in the use of the technology. In addition, training programmes on the management of change and on the didactic uses of the technology will help ensure the effective introduction of multimedia.

### 4.2.4 introduction of the technology

Aside from personal attributes, the time taken to complete a distance learning course depends on how easy it is to learn to use the course, how flexible and modular it is to fit in with day to day work, and how accessible it is.

Large organisation have usually quickly established a 'style' for their programs so that trainees do not have to learn how to use the programme each time before actually learning the material. On a wider scale it is clearly desirable to achieve a consistent user interface to training materials, both in terms of screen design and layout, and in dialogue design.

The trend towards graphical user interfaces provides part of the answer, but the standardisation needs to go much deeper if learners are going to be able to easily use each new programme without having first to understand how the software works.

### 4.2.5 evaluation

To proceed past the first programme and ensure the long term productivity gains promised by multimedia, it is necessary to continuously evaluate the effectiveness and efficiency of the programmes.

## 4.3 TOURISM. A HOTEL SCENARIO

A hotel scenario has been chosen in this hypothetical case study to illustrate the opportunities in the tourism industry.

### 4.3.1 the technology options

For a large hotel :

a hotel management computer with terminals for checking in and out, and in the restaurant, housekeeper and general office areas, a multimedia training station can be easily be added to the network.

For a medium sized hotel:

a tourist information system supplied by the tourist board, for example, can be configured to cope with two multimedia stations, one for the guests, and one for training in a back office.

For a small hotel:

the word processing personal computer can be upgraded to a multimedia workstation and used for training when its not being used for office work.

In all cases a low cost consumer multimedia system could also be used to deliver training.

### 4.3.2 implementation environment

Tourism is a major industry throughout Europe. Governments have a key role to play in improving the quality of service and facilities.

Multimedia is already being used in the tourism industry for point-of-sales and information systems. The opportunity exists to encourage the development of training programmes that will run on the equipment most likely to be used in this environment and to encourage the provision of the necessary multimedia elements if they are not a standard part of the operational systems.

In addition, a support structure for learners and management can be established to enable them to learn on the job, at open learning centres, or at home. Governments can support the provision of the necessary equipment and telecommunications networks and can also introduce technology based certification of qualifications gained via distance learning to enhance its use.



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### 4.3.3 on-the-job technical skills

In this scenario we examine a secretary expanding her knowledge of and skills in using a new word processor package.

- puts CD-ROM supplied by distributor of the package into her personal computer and plugs headphones into CD-ROM.
- proceeds through a guided tutorial which explains via a voice in her native language, the procedures she is using on the actual package, and supplements the (typically) English menus and help facilities with native language explanations, diagrams and instructions.
- a new computer system is being installed in the hotel and later that day she is scheduled to go to the training room and use the multimedia training station there to learn about the system, its role in the hotel, and the details on the section she will have to use. The supplier provides this training package in advance of installation to smooth the transition to the new system when it is installed.

**benefits:**

- improved office staff productivity and better guest services

### 4.3.4 on-the-job interpersonal skills

- the hotel manager is about to undertake the annual review of one of his key people. The hotel group introduced a new appraisal interviewing guideline and productivity bonus scheme, but it was some time ago that he had the initial training. The manager goes to the system to refresh his memory on the main points of the new scheme and review the techniques suggested.
- the new receptionist lad has been using the tourist information system to find out about the area, and he then goes to the training room for a session with the customer handling course supplied by the group. After completing the module he was scheduled to do he takes a few minutes to refresh his French because he knows there is a party arriving later that day.
- the new waiter also comes and takes part of his course on serving and table preparation, and a section on dealing with difficult customers.

**benefits:**

- upgrading service helps hotel to upgrade rating and thus charge more, attract higher spending tourists, create higher margins and generally upgrade the industry

### 4.3.5 open learning

- the receptionist is studying for a diploma in hotel management and takes a module after work from this course.

- at home the receptionist plays his favourite compact disc on the multimedia player supplied for use on his hotel management course. He then gets out the next training module and using this home multimedia system proceeds to work on his course. He finds he needs some background material and so uses his multimedia station to dial into the course centre computer and browses the information needed for his study.

- meanwhile the secretary is using the training facility to improve her English and takes a module of the Multimedia English Language course supplied by the tourist board to help improve language skills.

- the catering manager spends some time looking at the new programme issued by the authorities on health and safety in hotels. New regulations have been introduced and he needs to study them to make sure the kitchen meets the standard.

benefits:

- better trained staff without need for trainers or taking them away from work
  better motivated workforce through opportunities for study at home and work

## 4.4 THE MOTOR INDUSTRY, A DEALER AND SUPPLIER

A dealer location and a supplier factory have been chosen to create this hypothetical case study.

### 4.4.1 the technology options

The dealer has two multimedia work stations, one in the workshop linked to the engine diagnostic system, one in a training area linked to the parts locator and inventory control system, which also controls a point-of-sale system.

The factory has a single multimedia station in a training room.

### 4.4.2 implementation environment

Motor manufacturers working with a large network of suppliers and dealers use multimedia distance learning as a way of ensuring certain skills levels in their trading partners.

Large companies understand the benefits of multimedia distance learning and can provide SMEs with training programmes that their staff must use to attain certification as authorised suppliers or dealers. The large companies need to ensure a wide spread skills development in their trading partners to enable them to compete in world markets.

This can be accelerated by Governments through assistance in identifying key skills development needs and in the production of multimedia distance learning programmes to satisfy these needs.

### 4.4.3 on-the-job technical skills

- at the dealer a mechanic is doing a routine service when the engine diagnostic system detects a fault in the engine. It shows a picture of the faulty part and the location of this part in the engine compartment. It also shows the part number for the parts locator to check that the part is in stock. The service engineer has not had to replace this part before so he asks the system to show him the tools he needs and a step by step guide to replacing the part spoken in his native language.

- in the factory a new machinist is learning how to set up the computer controlled cutting tool. He is watching a simulation of the outcomes of the settings he has given the cutter and sees that the depth of cut was set too deep and a large swath is forming which is dangerous to the tool. He stops the simulation and tries another setting and sees a perfect cut this time.

- at the dealer the new service receptionist is taking a module of the course on how the parts locator system works and what she needs to do to find the parts from customer's brief descriptions.

benefits:

- continuously updating worker skills provides shorter service times and greater margin opportunity
- new skills learnt on-the-job to cope with new technology

### 4.4.4 on-the-job interpersonal skills

- the service receptionist is now taking a module of the customer care course learning how to deal with the many different situations she has to face. She is particularly interested in the 'dealing with the expert type customer' section, because just had to deal with a customer who got annoyed because she didn't understand immediately what the part was that he was trying to describe.
- the new salesman is taking a module of the course in closing the sale, because a potential customer left today without buying, when he felt he should have made the sale.
- the factory supervisor is taking a course on how to manage the introduction of new technology and deal with the personnel issues that arise from changes in the way the cell works.

benefits:

- greater skills meaning more sales and better service

### 4.4.5 open learning

- the salesman spends some of his time when there are no customers around learning about the new range of models and the new finance package announced recently. He also studies the analyses of the competitors products and refines his sales presentation.
- the service receptionist spends some of her time browsing the parts catalogue learning about the different models and how the parts have changed from model to model.
- at the factory, the work cell supervisor is studying the new statistical process control training programme supplied by his major customer who wants to see new levels of quality and flexibility from his suppliers.
- he is also learning how to use the new resource scheduling package about to be installed to improve productivity and utilisation of the equipment in his cell.

**benefits**:

- improved skills leading to greater productivity and meeting standards set by big companies encouraging use of local SME's

- improved skills leading to higher sales and greater profitability for company

## 4.5 THE TECHNOLOGY ISSUES

The key issue surrounding the above scenarios is that while all these things are possible today, it will take a long time to implement such systems if left wholly to market forces.

- without the installed hardware base, SMEs cannot take advantage of multimedia software for work based training and learning. Equally they cannot afford the cost or time of sending staff away for conventional training, and so the training often falls by the wayside.

- independent publishing establishments will only be interested in producing multimedia distance learning material when a significant installed hardware base exists to allow them the economies of scale required for their involvement. The personal computer software industry shows how the existence of a stable hardware base can encourage and facilitate the entry of publishers into the market. This software industry is enormous now but did not exist in its present form prior to the establishment of the computer base.

- it is necessary to create the awareness in both management and staff as to what the technology can achieve for them personally, and for the business as a whole. This will eventually come if the applications are very successful, but to accelerate the take up of the technology requires a significant effort.

# Chapter 5. Implementation scenarios

## 5.1 INTRODUCTION

From the point of view of businesses looking to implement multimedia distance learning it is clear that the various technologies identified in chapter 3 are at differing levels in the implementation process.

The stages of implementation are

- awareness
- strategy
- preparing the organisation
- implementing the technology
- next programmes

For those companies actively involved in multimedia at the moment the relative position of the technologies is shown in the table below.

## 5.2 CONSIDERATIONS FOR GOVERNMENT POLICY

Historically, national and regional authorities have helped stimulate the use of multimedia in many different ways.

- creating a 'standard' hardware platform for publishers and developers

  The US Department of Defence has, for example, stimulated the market by installing a very large number of interactive video workstations for training armed services personnel and subsequently commissioning many interactive distance learning programmes to run on them.

- creation of demonstration centres

  The UK government, for example, has subsidised the setting up of a national centre for interactive multimedia to provide awareness, training and expertise for companies considering its use. This also involved sponsorship from hardware and software suppliers in the industry.

- commissioning software

  The UK government has subsidised schools and further education projects to stimulate the use of technology in these and other areas. Other countries have also undertaken initiatives to help develop the industry.

### 5.2.1 national level

There is an opportunity for the European Community to follow these examples and develop a strong role in stimulating the further take-up of multimedia.

**Governments have a role to play in the successful implementation of multimedia distance learning by assisting with:**

- **the creation of national or regional centres of expertise**
- **the establishment of the developer infrastructure**
- **the development of a hardware and interactive programme base**

### centres of excellence/expertise

To assist business in the awareness and understanding stage of introducing multimedia distance learning a major opportunity exists for government bodies to assist in setting up demonstration centres. These centres should have a wide range of applications on show, provide expert advice and training in the use of multimedia and be a link to development resources both locally, if they exist, and in other countries or regions.

### infrastructure, upgrading AV and computing expertise

Designing and developing multimedia programmes requires a set of skills which can be developed from existing audio / visual producers, teachers and trainers, computer professionals and many others. Government assisting training schemes can provide the basic skills.

Training in the techniques can only be turned into real skills by practice, and this needs a flow of programme production to allow it. Government bodies can assist in the development of these skills by commissioning programmes for their own use.

### subsidies for training technology

Without a reasonably large installed base of systems that can deliver multimedia training it will always be difficult for publishers to justify the considerable expense of producing interactive multimedia programmes. There is a clear need for some way of stimulating the creation of this base of multimedia systems.

Government bodies have a variety of ways of assisting in the creation of this base, but however it is done, it needs to be done on a sufficiently large scale to overcome this barrier for publishers.

A reasonable number of published programmes need to become available to help organisations make the decision to move toward multimedia training. Bespoke programmes may be cost effective for large organisations, but it is the catalogue of published materials that will speed acceptance of multimedia distance learning.

There is a reasonably large base of interactive training packages using the English language, and this creates opportunity for governments to assist in the translation or cultural transposition of these programmes to their own national context, or to other hardware platforms.

In addition, there will be nationally critical issues for which distance learning packages could be developed, and governments have the opportunity of commissioning or subsidising programmes to meet these priority skills development needs.

## 5.2.2 european level

The European Community has invested heavily in research and development activities in multimedia and distance education and training. The multimedia technology, both hardware and software, is now sufficiently mature for the knowledge and expertise built up as a result of these activities to be applied the skills shortages problem.

**The European Community has a significant role to play in assisting the successful take up of multimedia distance learning in the areas of:**

- **standards**
- **support for Europe-wide priority applications**
- **multimedia skills development**

## standards

The successful widespread implementation of multimedia distance learning in the European Community requires an adequate level of standardisation. Market forces will create the hardware standards. It is in the area of software standardisation that a role exists at the European level.

Multimedia programs have for many years been based on a variety of proprietary user interfaces. However the personal computer market is heading towards a standard set of graphical user interfaces and these will help to establish a standard at the 'look and feel' level for many applications. There is a role for the European Community to promote the use of market derived standards to make applications easy to learn and use. By presenting a similar user interface to that used in other personal computer applications, distance learning packages well be more acceptable to learners.

The newer generation of object oriented authoring packages indicate a path towards multi-platform applications. Encouragement in the development of a multi-level structure for distance learning applications will help establish some standards for programme development. An opportunity exists to help the publishing and software industry to develop a set of guidelines which will encourage the creation of multi-platform applications.

A model of the sort of layered software which can be developed using these techniques is included here for illustration only. There is a need for much of the R&D work and the actual practice in the industry to be brought together to help identify the requirements for the next generation of authoring software.

## support for europe-wide priority applications

By working with industry to establish short term priority needs and then assisting in the implementation of multimedia programmes to address some of these needs, a substantial start can be given to the take up of the technology.

A clear priority exists in the area of training the trainers and management in the use of multimedia to address training needs within industry. However considerable work needs to be done to establish exactly what the best approach is for this in different regions, and to establish other priority application areas. Establishing priority needs helps publishers make the investments needed to produce effective programmes by identifying Europe-wide requirements for these programmes.

## multimedia skills development

There are many skills needed for the successful wide spread implementation of multimedia distance learning. An opportunity exists for the European Community to encourage the development of these skills over a wide geographical area and over a broad range of existing staff.

## 5.3 POSSIBLE IMPLEMENTATION SCENARIOS

### 5.3.1 no clear winner

In this scenario the market dictates no particular winner, and the various platforms follow their own unique positions. For example, CD-I into the home and education, PC platforms into business and others into their own niches. There would be little standardisation and no coherent market for publishers to aim at.

### 5.3.2 the consumer electronics industry leads.

In this scenario we see CD-I type systems prevailing, with these capabilities also appearing as PC plug in cards, providing a low cost option due to the high volumes in the consumer market.

### 5.3.3 PC industry leads

In this scenario CD-I type systems remain primarily as consumer platforms and do not become a major multimedia platform for business. The costs take longer to fall as the PC industry strives for high quality digital video, rather than the medium quality already available. A lower level of standardisation may also result as competing manufacturers strive for supremacy.

### 5.3.4 publishers lead

In this scenario the major European publishers take the lead and define a minimum functionality set for the software which allows them to produce multi-platform programmes thus avoiding the PC versus CD-I issue.

### 5.3.5 education and industry lead

In this scenario the education and large, small and medium sized industry users define a joint set of requirements and lead suppliers into a reasonably standardised set of functions for implementing multimedia across the major platform.

The table on the following page analyses these scenarios with respect the factors we believe are the main issues:

- standards
- cost
- packaged programmes
- authoring
- number of suppliers

# A software led development provides best opportunity

| | Standards | Cost | Packages | Authoring | Suppliers |
|---|---|---|---|---|---|
| No clear winner | • | ● | • | • | • |
| CD-I leads | ● | • | ● | ● | ● |
| PC suppliers lead | ● | ● | ● | ● | ● |
| Publishers lead | ● | ● | ● | ● | ● |
| Users lead | ● | ● | ● | ● | ● |

Rating

- • low
- ● medium
- ● high

# Chapter 6. Conclusions and recommendations

Multimedia is a well proven technology for distance learning. However the awareness of its potential to greatly enhance the productivity of training is generally low throughout the Community. Also, there are many technology platforms which can deliver varying levels of multimedia functionality with differing costs and quality factors. These platforms include hardware and software, and both need to be taken into account when considering technology options.

Technology should only be selected for any particular purpose once the skills development needs have been established. The most appropriate technology or combination of technologies will depend very much on the type of training being given, to whom it is being given, where and when. No single technology will be 'best' for all situations all of the time. A detailed needs analysis will help establish the characteristics required of the technology for the training tasks identified.

## 6.1 AWARENESS

There is a need to raise the level of awareness in the Community of the benefits of interactive multimedia training for business and for individuals. To meet the overall objective of maintaining a healthy economic balance across the Community particular emphasis should be put on remote and less favoured regions.

- **we recommend that the Commission should work together with large companies and national bodies to investigate the approaches to building a large base of hardware platforms suitable for the priority applications identified in the needs analysis**
- **the objective of this investigation would be to find ways of subsidising the cost of the equipment to ensure rapid take up**

After the initial awareness programme was in place, these centres could then become the focus of expertise for the region. In addition they could become the support centre for an evolving distance learning network and provide the message store and forward telecommunications services needed for the support infrastructure of the distant learners.

Likewise, training in the management of technological change and in the appropriate use of technology in training which is already identified as a priority need with the Community could be initially supported from these centres. Multimedia is an ideal instrument for achieving these training objectives. Not only is it a very efficient and effective technique, but using the technology itself to learn about its uses, is far superior to any other form of promoting multimedia.

## 6.2 NEEDS ANALYSIS

The increasing rate of technological change is both forcing and allowing big companies to adapt their organisations to a more flexible and less structured form. Rigid functionally structured organisations are proving in many industries to be uncompetitive on world markets. Many companies have successfully changed to a more operationally based process organisation and moved away from the functional structures. Technology often plays a central role in allowing a more decentralised and autonomous method of working in smaller focussed units, while still maintaining overall corporate control.

Experience shows that a carefully structured introduction of new technology accompanied by an appropriate employee communications and training programme greatly improves the chances of a smooth successful transition to a new way of working. Multimedia distance learning has been used to good effect by some large companies in meeting these communication and training needs. However large companies need small and medium sized enterprises to supply many of the goods and services they require. New ways of working in the large company will often have a direct effect on the way the SME's have to interface with them, and force new ways of working onto the SME's as well.

SME's do not typically have the resources to use the multimedia technologies to help them introduce their own changes and often have to fall back on conventional classroom or on-the-job learning techniques which are generally less efficient and effective. Large companies in conjunction with governments and trade associations can work together to find ways of giving SME's access to appropriate multimedia distance learning. This task can only be started once there is a general agreement as to what the appropriate training needs are, both within big organisations and for SME's.

- **we recommend that Europe's top 100 companies should work with the European Commission and other relevant and interested parties to identify priority needs for themselves and for the SMEs working with them**

- **the objectives of this analysis would be to document immediate Europe-wide training needs that can be addressed by multimedia, and to create a technology selection framework for making choices about which technologies should be used to deliver this training**

## 6.3 HARDWARE

The creation of a hardware base for delivering multimedia training is essential to stimulating the creation of published skills development materials.

Using modern software techniques it is possible to provide a similar set of functions for applications developers from a wide variety of hardware platforms. For example, it is generally unimportant to an application developer when a sequence of motion video is to be played, whether it is from an analogue or digital source. Similarly it is relatively unimportant except in certain simulation environments, whether the material is coming from a broadcast signal, a telecommunications network or a local device.

What is important is that a hardware base is created with a set of software functions which are adequate for a wide range of applications, regardless of the actual detailed implementation of those functions.

Until the number of standards for storage formats in common usage is reduced, publishers may have to support a number of storage and distribution formats. However, the major costs are in the design, development and marketing of the application. The formatting and pressing of the distribution material, while not negligible, is at least a small part of the overall cost.

- **we recommend that the Commission should work together with large companies and national bodies to investigate the approaches to building a large base of hardware platforms suitable for the priority applications identified in the needs analysis**
- **the objective of this investigation would be to find ways of subsidising the cost of the equipment to ensure rapid take up**

## 6.4 SOFTWARE

The availability of appropriate software is the key to the success of multimedia distance learning. However as with most creative activities, many solutions are possible for a programme meeting a particular training requirement. It is difficult to prejudge which method will work best. Indeed different methods will probably work best in different countries, and even then, variously with different learners in those countries. What is certain, is that many of the published programmes have worked well.

Only experience will show which approaches work best for which subjects. Much research has been undertaken into learning and teaching styles and the results of these researches should be put to the test in practice.

- **we recommend that the priority training applications should be developed and that this development should be heavily supported by the European Commission**
- **we recommend that these applications should be strongly promoted to major publishers and that developers should produce programmes that are multiplatform**
- **we further recommend that both commercially used authoring approaches and those nearest the market from the research programmes should be used to determine some 'best' authoring practices**

## 6.5 STANDARDS

Many standards are defined or are under investigation in the multimedia arena. The consumer electronics led standards for CD-Audio and CD-I have been published and accepted by a number of major suppliers. The International Standards organisation has defineda still picture encoding standard and has released a draft moving picture encodirg standard. Laservision is a world wide standard for videodisc. Similarly there is a maket driven trend towards a small range of standardised graphical user interfaces for personal computers.

The issue therefore becomes one of ensuring an adequate level of standardisation to allow publishers to provide programmes that will run on a number of commonly available platforms. This can be assisted by developing a framework for each of the priority application areas which defines a minimum set of functionality needed from any platform aiming to support these applications.

- **we recommend that the Commission should promote an adequate level of standardisation to ensure that publishers can produce multi-platform applications**
- **we recommend that a framework of minimum functionality be developed for the priority applications and that this standard should be strongly promoted to all suppliers**

## ANNEX

### Definitions

| | |
|---|---|
| Bulletin board | Electronic message store and forward services |
| CD-I | Compact Disc Interactive |
| CD-ROM | Compact Disc - Read Only Memory |
| CD-ROM-XA | Compact Disc - Read Only Memory - Extended Architecture |
| CDTV | Commodore Dynamic Total Vision |
| JPEG | Joint Photographic Experts Group, an ISO working party |
| MPEG | Motion Picture Experts Group, an ISO working party |
| NTSC | The television standard used primarily in America and Japan |
| Laservision | A worldwide analogue videodisc standard |
| PAL | The television standard used in most parts of Europe |
| SECAM | A similar system to PAL used in some parts of Europe |